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SEVENTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

NEW YORK
Agricultural Experiment Station,

(GENEVA, ONTARIO CO.)

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FOR THE YEAR 1888,

WITH REPORTS OF THE DIRECTOR AND OFFICERS.

TRANSMITTED TO THE LEGISLATURE FEBRUARY 27, 1889

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STATE OF NEW YORK.

No. 11.

IN ASSEMBLY,

FEBRUARY 27, 1889.

REPORT

OF THE

BOARD OF CONTROL OF THE NEW YORK AGRICULTURAL EXPERIMENT STATION.

Hon. Fremont Cole, Speaker of the Assembly:

SIR.—I herewith transmit to the Legislature the Seventh Annual Report of the New York Agricultural Experiment Station.

Very respectfully,
Your obedient servant.
N. M. CURTIS,
President Board of Control.

334585

REPORT OF THE EXECUTIVE COMMITTEE.

When this property was purchased by the State, the dwelling, which was very spacious and expensive, was considerably out of repair. The barns, stables and other outbuildings were in still worse condition, and so badly arranged that the expense of storing crops therein and removing them for threshing or feeding often absorbed a great portion of their entire value. They could not be repaired nor reconstructed with economy, but some of them might answer, at least temporarily, for storing and exhibiting the agricultural implements which we were assured would be donated to the Station by our leading manufacturers, and others might be used for the valuable varieties of swine, of which the Station already possesses a considerable number, and possibly others might be used for poultry, though it will be better to build new for this purpose, with sufficient land and suitable arrangements for developing this important industry.

We were urged by representatives of associations having the most valuable herds of cattle in the country to prepare fit and suitable stables and stalls for selected specimens of these valuable animals, so as to make a perfect test of rearing and feeding representatives of the various breeds, and, for the first time in the history of our agriculture, to subject all to the same care and the same system of feeding. If we had not been subjected to great and unexpected delays by the extraordinary season, which compelled us to work our mechanics in the storm for more than three-fourths of the time, and in overcoming the obstacles to a secure foundation, we might to-day exhibit from twenty to twenty-five head, the best specimens of registered animals of the most valuable breeds in the country, all the gift of our enterprising and liberal breeders. Letters continue to pour in upon the director to this time, urging us to hasten to completion the accommodations for these cattle. We are now only waiting for the proper set of our cement floors and the thorough drying of the basement story.

As the extra appropriation of $8,000, granted at the close of the late session of the Legislature, for constructing a new barn, the purchase of live stock, agricultural implements, etc., became available, we were satisfied that not much, if anything, need be paid for the stock or implements, as the owners thereof had decided to donate them; and this left us sufficient funds to construct a model barn, containing a spacious and perfectly ventilated stable, an elaborate and improved "silo," and convenient rooms for meteorological observations, all of which are provided for in the new building. While its cost has absorbed about all the money provided by the State for this purpose, we can not discover where any saving could have been made without impairing the utility of the provisions made for these various objects. While we have carefully studied to avoid all extravagance and useless expenditure, we have kept in view that all practical farmers who visit the Station entertain the opinion that this property, on which nature has bestowed its choicest bounties, and on which the former proprietor expended not less than fifty thousand dollars in buildings and other improvements, should be made in all respects a model farm, and that the experiments by its managers should not only embrace all of the scientific objects which have hitherto occupied the main attention of the director, but extend to every acre of the farm and every building, every other improvement, and every animal reared upon the place. For the past six years, as well as many years prior to the purchase by the State, no improvements or repairs had been made, and as a necessary consequence the fences had been destroyed on the greater portion of the farm, noxious weeds had supplanted the crops, the once splendid and bountiful supply of water had no longer any avenue to the place, and the most valuable of the buildings were literally tumbling down over the heads of the family of the director. The necessary repairs of the residence have been made, the water-works have been reconstructed, carrying to all the buildings and all the stables a bountiful and reliable supply of pure and wholesome water, and other improvements which could no longer be avoided without destruction to the property of the State have been accomplished. But in doing this work, there being no special appropriation for many of these purposes, we have necessarily used about $5,500 of the funds granted to the Station for general purposes.

WM. W. WRIGHT,
JAMES McCANN,
CHAS. JONES,
Executive Committee.

CROPS PRODUCED IN 1888.

	Acres.	Amount produced.	Price.	Amount.
Hay	33.67	70 tons	$12 25 a ton	$857 50
Barley	.516	15½ bushels.	90 a bushel	[illegible] 00
Barley, oats and peas	2.95	118 bushels	50 a bushel	
Straw of barley, oats and peas	......	18 tons	8 00 a ton	144 00
Oats	14.00	729 bushels	35 a bushel.	255 15
Oat straw	......	18 tons	....	....
Merchantable corn	14.40	750 bushels	44 a bushel	330 00
Soft corn	......	....	....	....
Stover	......	32 tons	5 00 a ton	160 00
Maize fodder (green)	4.40	55¾ tons	6 00 a ton	334 50
Sorghum fodder (green)	.33	....	....	....
Maize fodder	.419	....	....	....
Carrots and turnips	.59	400 bushels	20 a bushel	80 00
Sugar beets	.80	430 bushels	25 a bushel	107 50
Potatoes	2.00	239 bushels	40 a bushel	95 60
Apples	......	50 barrels	1 00 a barrel	50 00
Pears	11.50	....	....	10 00
Peaches				5 00
Strawberries,				50 00
Melons				50 00
Grapes				15 00
Vegetables				75 00
				$2,692 20
Pasture	10.53			
Railroad cut and corner	1.125			
Balance experiment plats	6.35			
Baildings and lawn	5.78			
Tenement lots	.64			
Arboretum not planted and highway	15.00			
	125.00			

TREASURER'S REPORT.

GENEVA, N. Y., *October* 1, 1888.

To the Board of Control of the New York Agricultural Experiment Station:

As treasurer of the board of control, I do respectfully report:

That I have received from the Treasurer of the State of New York for the twelve months ending September 30, 1888	$20,000 00
That the balance on hand October 1, 1887, was	1,309 81
Total	$21,309 81

And I do further report that I have expended during the twelve months ending September 30, 1888, the sum of $20,800.75, vouchers for which, duly audited by the special auditing committee of the board of control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows:

Board of Control	$982 57
Farm	51 58
Freight, cartage and express	231 06
Fuel	266 97
Furniture	76 20
Labor	5,934 88
Laboratory department	25 76
Library	462 99
Permanent improvement	910 49
Postage expenses	275 00
Printing	140 15
Repairs	1,375 45
Salaries	8,351 58
Carried forward	$19,084 68

Brought forward	$19,084 68
Stationery	137 98
Sundries	33 35
Supplies	1,052 82
Travel	288 30
Insurance	203 62
	$20,800 75
Balance on hand	509 06
	$21,309 81

And I do further report that I have received from sales the sum of $173.19, which sum has been duly paid to the Treasurer of the State of New York.

And I do further report that I have received from the Treasurer of the State of New York, on account of special appropriation, $8,000; that I have expended on this account $2,498.02, vouchers for which, duly audited by the special auditing committee of the board of control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows:

Farm	$60 00
Farm implements and tools	275 13
Laboratory department	309 00
Live stock	823 86
Manure and fertilizer	481 77
Scientific apparatus	338 17
Barn account	210 09
	$2,498 02
Balance on hand	5,501 98
	$8,000 00

WM. O'HANLON,
Treasurer.

DIRECTOR'S REPORT.*

To the Board of Control of the New York Agricultural Experiment Station:

GENTLEMEN. — I herewith submit the seventh annual report of the Experiment Station for the calendar year 1888.

Upon the resignation of my predecessor in office, Dr. E. Lewis Sturtevant, I was, October 20, 1887, elected as director of the Station and entered upon the active discharge of my duties December 1.

Since the purchase of the Station property by the State much has become necessary in the way of repairing, but owing to the limited appropriation compared with the extent of work upon which it was necessary at once to enter, there were not sufficient funds with which to make these necessary repairs, and in consequence very many matters were found demanding immediate attention in order to preserve the property from loss.

These repairs, which have been very extensive, have largely occupied my time and attention during the past year. As yet they are not wholly completed, but little suffers by the delay which the close of the season necessitates.

In brief, the repairs made have been the painting of the house without and within, papering and putting in new floors in many of the rooms, replacing sills and beams which were decayed, relaying the flagging and some of the walls, which have been injured by action of frost, extending the system of steam radiators to the third story, relining and painting the fence, repairing the fountains and the drive through the grounds, and in short doing that only which was needed to place the property in a proper and safe condition.

Besides the lines of investigation hitherto pursued at the Station, it seemed best to take up others which appeared to be of especial interest to the farmers of the State, and to further these investigations there was pressing need of increased facilities in barn room and accommodations, as there was no barn upon the place into which it was possible to drive with a load of hay or grain, and no facilities for weighing a load of these crops.

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*Peter Collier, A. M., M. D., Ph. D.

The following statement, which was prepared and presented before the Senate Committee on Finance, is reproduced, as it presents in brief the past history, the present condition and the pressing demands of the Station, if it is to be able to provide for the future work which is demanded of it by our agricultural community.

Unfortunately this statement was presented to the Legislature at a date so near the close of the session that it could not receive the consideration its importance demanded, but to provide for the more pressing wants there was made an appropriation by the Legislature of the sum of eight thousand ($8,000) dollars "for erection of barn, and for the purchase of farming and scientific implements, live stock and fertilizers."

THE STATE AGRICULTURAL EXPERIMENTAL STATION AT GENEVA.

Some of the Reasons why Additional Appropriations are Needed.

The following statement is made because there appear to exist in certain quarters grave misconceptions as to the work of the Station in the past, the practical and scientific value of the work done, the economy of its management and the necessity of additional aid in order that it may enlarge its sphere of usefulness. If the criticisms which have occasionally been heard concerning the Station were just, if the statements upon which such adverse criticisms are based were true, or even approximately so, there can be no doubt of the moral and legal duty of the Legislature to abolish the Station at Geneva, and at once, even were it the last hour of the session.

This statement, therefore, is made to show that the gravest error has been made in such criticisms, and to inform those who may be called upon to discuss these matters when they are presented to them for consideration.

I have taken certain facts and statements from a recent address upon scientific agriculture by President Adams, from which I quote mainly from memory at this writing.

I desire at the outset to state that I have prepared this statement not as the director of the Experimental Station, which position I have but recently been called upon to assume, but rather as an outsider, an expert familiar for the past twenty-five years with the work which such Stations have been engaged in, and with the work which has been done during the six years of its existence at your Station by my predecessor, Dr. E. Lewis Sturtevant.

Whatever of merit that work has belongs wholly to him and not to me, and I wish to state that under my administration, if it shall be continued, I have no thought to abandon, but rather to *supplement* the work which, in my best judgment, has been wisely planned and faithfully and economically carried forward. Please, therefore, consider what I may say as in the nature of expert testimony, and without personal bias.

The First Napoleon declared that agriculture was the basis of all national prosperity. Everybody knows that when he set aside 1,000,000 francs annually for the establishment and maintenance of six experiment stations for the development of the beet-sugar industry alone, he laid the foundation of an industry which to-day controls the markets of the world in this important commodity, and which has reduced the cost of beet-sugar from forty to less than three cents per pound.

Everybody knows that it was the ambition of Frederick the Great to make his realm the foremost power in Europe. One hundred years ago his sagacity led him to appropriate $32,000,000. a year to the development of the agricultural resources of Prussia, and this, too, when his kingdom was small and impoverished.

Every new disaster was met by some new expedient for strengthening the productive resources of the country. Just after the battle of Jena, when the territory of Prussia had been reduced to about half the former area, the famous school of Moeglin was founded. After the revolution of 1848, the department of agriculture was placed under a special minister. After the battle of Sadowa the agricultural college of Leipsic was established, and $60,000 was given to provide scientific instruments and the appliances of instruction alone. To-day twenty professors in this institution devote their entire time to matters pertaining to agriculture.

What are the results? A century ago much of Prussia was barren plains of sand, wild and absolutely unproductive ; more of it was swamps and morasses, wholly given over to wolves and bears. To-day those sandy plains and those trackless swamps are the gardens of Europe.

To-day, in the German Empire alone, there are 184 agricultural experiment stations wholly devoted to the development of what Washington truly declared to be the noblest occupation of man.

In England one man established, and for forty-five years has maintained with a permanent endowment of $500,000, an agricultural experiment station at Rothamstead. It would take a day to recount the valuable service which this institution has rendered to English agriculture. In brief, it may be said that, within the past thirty years, the average yield of crops in England has been *almost trebled.*

To-day there is not a reasonable doubt that with no increase of labor, but simply with increased intelligence, the agricultural productions of the Empire State may be within ten years doubled and the profits increased ten-fold.

The following statement has been prepared by a member of the Board of Control of the Station who has been personally acquainted with the works of the Station since its establishment.

The Agricultural Experiment Station at Geneva was organized about six years ago. The property belonged to a deaf-mute who had no skill in farming, and no conception of the economy of keeping the premises and buildings in proper repair. At the price which the State paid for this property, $5,000 to $10,000 might have properly been set aside for putting the farm in proper condition, as would have been done if the property had been purchased by a gentleman farmer of pecuniary resources. But Dr. Sturtevant deemed it best to ask at that time for no money beyond the allowance required for the fitting up of rooms and providing of implements and scientific apparatus, and the employment of competent professors in the various departments of scientific agriculture, a limited supply of tools and agricultural implements and the necessary fixtures of an ordinary farm. Down to the date of Dr. Sturtevant's resignation very little attention was paid to the farm proper, but the results of the scientific experiments of the Station have proven highly important and satisfactory to the most eminent and learned agriculturists of this country and Europe, and it is a significant fact that there is scarcely one of the corps employed at this Station who has not been invited to take positions at agricultural colleges and experiment stations of other States at largely advanced salaries. But the policy hitherto pursued at this Station has nearly ignored all experiments in stock-raising, and such fair comparison in the value of the various breeds as can only be determined by subjecting *all* to the same treatment in feeding and care, and utilizing the farm to determine the true value of the various fertilizers now in general use and about which our farmers are so anxious to get reliable information. A change in this policy is now deemed very desirable, more especially as some of the most noted cattle-breeders in the country offered to donate to the Station some of the most valuable animals of their herds. But before the director is in a condition to accept these generous and valuable gifts, the farm must have fences, buildings, manures, farm implements and proper cultivation. Scarcely a practical farmer has visited the Station for the last year without expressing a desire that they should find upon the State farm herds of cattle, sheep and swine, about whose management, rearing and feeding they can get authentic facts, and something reliable about the various phosphates and other fertilizers.

Another new departure, which is deemed desirable, is establishing at this Station a department of agricultural implements, such as are usually found at our annual fairs, State, county and town. The peculiar advantage of concentrating them at this point is that it would enable purchasers to test the relative merits of each at all times, and get at the impartial tests made by the managers of the farm in their own fields. It is not believed that the cattle and other animals and these farm implements would cost the State any money beyond the expense of providing suitable buildings for the tools, and barns and sheds for the cattle, sheep and swine; and it is believed that all the animals which can be well kept, and all the implements which are desired, according to the assurances already given, will be cheerfully donated by the owners and manufacturers. But one of the committee has suggested that beyond the cost of the barns and repairs of the house the funds to make these improvements can be taken from the regular appropriation. But the objection to that proceeding is that it must result in impairing or breaking up and discontinuing the experimental work for which the institution was originally established, for there is not now, and there is not likely to be in the future, any surplus of this appropriation, if we are to continue this work on the scale anticipated when it was commenced. The experience of the last six years has suggested no branch or branches of this work which can be carried on at less expense or advantageously discontinued. On the contrary, we are constantly reminded that if we had the means we could establish additional departments with decided advantage to the great interests we are endeavoring to serve.

The work at the Station during the past six years has been economically done. I present in Exhibit A a list of those States which had experiment stations in 1886, nine in all: Alabama, Connecticut, Maine, Massachusetts, North Carolina, New Jersey, New York, Ohio and Wisconsin. The number of farms in each State, number of farmers, population and aggregate value of annual farm products is taken from the census of 1880.

I present also, in Exhibit B, the annual State appropriation for each experiment station in each of these nine States, the total of salaries paid in each, the number of salaried officers in each, the per cent of the appropriation paid for salaries, the amount of tax to each farm in the State if the appropriation was wholly assessed upon the farms, the tax to each farmer if they alone were assessed, the tax *per capita* upon the whole population, the percentage of the assessments upon the aggregate annual value of farm products in 1879. I desire to call attention to a few points disclosed in this Exhibit B.

EXHIBIT A.

States having Experiment Stations in 1886.

	Number of farms.	Number of farmers.	Population.	Aggregate value of farm products.
Alabama	135,864	380,630	1,262,505	$56,872,994
Connecticut	30,598	44,026	622,700	18,010,075
Maine	64,309	82,130	648,936	21,945,489
Massachusetts	38,406	64,973	1,783,085	24,160,881
North Carolina	157,609	360,937	1,399,750	51,729,611
New Jersey	34,307	59,214	1,131,116	29,650,756
New York	241,058	377,460	5,082,871	178,025,695
Ohio	247,189	397,495	3,198,062	156,777,152
Wisconsin	134,322	195,901	1,315,497	72,779,496

EXHIBIT B.

	Annual appropriation.	Salaries.	Number of salar'd officers.	Per cent of appropriation for salaries.	Tax if assessed on farms.	Tax if assessed on persons employed in farming.	Tax per capita total population.	Rate of if assessed on aggregate annual value of farm productions, 1879.
Alabama	$7,800	....	......	......	$0.055	$0.02	$0.0059	$00.013
Connecticut	8,000	$6,925 52	5	86	0.262	0.18	0.13	00.044
Maine	5,000	2,985 00	4	59	0.077	0.06	0.0077	00.023
Massachusetts (*a*)	10,000	3,149 75	2	31 (*a*)	0.26	0.154	0.0056	00.041
North Carolina	8,000	....	......	......	0.058	0.0222	0.0057	00.015
New Jersey	11,000	7,176 06	7	65	0.3206	0.186	0.0097	00.037
New York	20,000	8,820 00	8	45	0.083	0.053	0.0039	00.011
Ohio (*b*)	5,000	1,930 00	6	38 (*b*)	0.0202	0.0125	0.00156	00.003
Wisconsin (*c*)	5,000	....	5	......	0.06	0.041	0.0061	00.011

(*a.*) Graduate students employed for small compensation.
(*b.*) Director and part of two other officers paid by college.
(*c.*) Salaries mostly paid by college.

EXHIBIT C.

NAME.	Received at Station.	Receives now.	State.
Mr. Plumb	$1,000	$1,800	Tennessee.
Mr. Babcock	1,800	2,000	Wisconsin.
Mr. Arthur	1,000	1,600	Indiana.
Mr. Goff	1,000	1,000	
Mr. Ladd	660	1,800	

1. The per cent of the appropriation paid for salaries is less in New York than in either of the others of which the records are fully given. Connecticut pays eighty-six per cent, New Jersey sixty-five per cent, Maine fifty-nine per cent, and New York but forty-five per cent.

2. The average salaries paid to the officers are lower than in most States, for the average salary in Connecticut is $1,400, in Massachusetts $1,575, in New Jersey $1,025, and in New York $1,100; and in this connection I wish to call attention to Exhibit C, where it appears that one employé of your Station, who was paid $1,000, has been called into like service in Tennessee at a salary of $1,800; another, who received at your Station $1,800, has been called to carry forward in Wisconsin the same work he did at Geneva and receives a salary of $2,000 and certain perquisites materially increasing his salary; still another, who was receiving at your Station $1,000, has been called to Indiana for the same service he gave you, and receives $1,600 and his expenses in a trip to Europe as additional compensation.

Still another, who has been working at your Station for the pitiful sum of $660 a year (pitiful for the valuable services he has performed), has recently been advanced to a salary of $1,800, and is now urged to accept positions in Vermont, Maryland, Iowa and Virginia, at an increase over what he now receives.

Finally, another, who receives at your Station $1,000, is being urged to accept another place in a neighboring State for $1,500.

It thus appears that the scientific work which has been done at your Station has been secured in every instance at less cost than other States have been and are willing to pay for the same service. I repeat, then, that the fact that these men have been called away to continue their labors in other places, and at greatly increased compensation, clearly proves that the work they performed was excellent and valuable, and that their work was secured, as we may say. at much less than the true market price.

3. It appears also from Exhibit B that were this entire appropriation levied upon the farm the average annual cost to each farm in New York would be less than eight and one-third cents, while in Connecticut and Massachusetts it is three times, and in New Jersey four times, as great. If assessed only upon the farmers it would constitute an annual tax upon each farmer in New York of less than five and one-third cents; Connecticut, Massachusetts and New Jersey farmers paying three times as much. If levied upon the population it is less than four mills per capita per annum, while the good people of Connecticut groan under a per capita tax, for this purpose, of over one cent per annum, and the inhabitant of New Jersey is nearly as heavily burdened. Finally, we find that this annual appropriation is only $\frac{1}{1000}$ of one per cent of the aggregate annual value of the farm crops of New York, while it is nearly four times as great in Connecticut, Massachusetts and New Jersey.

Certainly no one can count this an oppressive burden; were it one hundred times as great it could scarcely be felt, and the results flowing from such increased facilities in the solution of the countless problems which stand in the way of advancing agriculture would in a decade repay this expenditure a hundredfold.

4. I desire to call attention also to the fact that this work done at your Station these last six years, has been of very great value, and has been directly in the line of the best work done by similar Stations not only in this country, but in every country of Europe.

Professor Henry E. Alvord, of Amherst Agricultural College, recently elected as director of the experiment station in Maryland, in a late paper, in which he elaborately discusses the question of milk, butter, cheese, etc., makes (13) thirteen distinct references to the invaluable work in this direction which has been accomplished at your Station at Geneva. Very clearly Mr. Alvord is of the opinion that your Station has done valuable scientific and practical work in behalf of this immense dairy interest, in which, as you well know, the Empire State stands at the head of all the States of the Union.

Whatever of criticism may be justly brought against the work of Dr. Sturtevant, is for sins of omission, and of those no one was more cognizant than he; but those were faults, if faults they were, for which he was no more to blame than was any other intelligent citizen of the Empire State. I think he erred, I think we all have erred, perhaps, in failing to fully appreciate our opportunities and our responsibilities in this matter; have erred, perhaps, in failing to appreciate how much such a Station could do to render agriculture more productive and more profitable.

Let me briefly recall a little of the history of agricultural science:

In 1795 the Earl of Dundonald published the first book in the English language on agricultural science, entitled "The Intimate Relation Existing between Chemistry and Agriculture." In 1838 the Göttingen Academy offered a prize for the solution of the problem whether mineral matter was necessary for the development of a plant. In 1851 the first public experiment station was established at Moeckern, Saxony. In 1861 fifteen had been established; fifty-six in 1871; sixty-three in 1873, and at present there are in the German empire alone 184, devoted exclusively to the solution of the various agricultural problems which are continually rising in practice. Besides Germany, numerous stations have existed for years in Austria, France, Italy, Switzerland, Sweden, and other countries. Two notable private farms and experiment stations have been established which deserve mention: The laboratory and farm of Boussingault, near Strasburg, established in 1835; the laboratory and experimental grounds of Rothamstead, which were established in 1845, and have an endowment fund by Mr. Lawes of 100,000 pounds sterling. In addition to the above there exist the Highland Agricultural Society of Scotland, established in 1849; the Royal Agricultural Society of England established about the same date; the Royal College of Cirencester, the laboratories of Giessen and Munich, where Liebig labored, and that at Tharrandt, famous for the work of Stoeckhart.

The work done at these public experiment stations consists largely of feeding experiments with cows, oxen, calves, sheep, swine, etc., to determine the best constituents of rations, greatest economy in fattening, effects of different foods on yield and quality of milk and butter, the value of steaming food, the relative value of different fodders, roots, grasses, hays, clovers, brewers' and distillery wastes, etc., the careful study of solid and liquid excrements of animals under different feeding trials, digestion experiments, fertilizer experiments on various crops to determine the effect on quality and quantity with almost every variation and modification, soil temperatures at different depths and during different seasons, drainage waters, their composition and flow, and fertilizer control; and in this country during the past twenty years the effect of this control has been to increase the average intrinsic value of commercial fertilizers thirty-one per cent. The average cost has decreased during the same period fifty per cent; or in other words the average saving amounts to 61.43 per cent, *i. e.*, to-day one may purchase the same amount of fertilizing material for $38.57 which would have cost him $100 twenty years ago.

You will please observe that this annual saving to the people of this State in this single matter of fertilizers many times repays the expense of your Station since its establishment, and this is a matter easily estimated in dollars and cents; but no intelligent person can doubt that greater pecuniary results have proceeded from these experiment stations than even this, and many greater results are yet to follow.

The average acreage yield in the farm crops of England has been more than doubled within twenty-five years; the same may be done in New York; the average yield of many dairy herds, in this State and others, has been more than doubled within twenty-five years; the same may be true of our million and a half of dairy cattle in this State.

You will observe, also, that in the list of investigations pursued at these several Stations to which I have referred, you will find everything which has occupied the attention of your Station for the past six years. Whatever of criticism may be directed against the work of your Station therefore may be brought against those who have spent their lives in their effort to advance our knowledge of the fundamental principles of agricultural science, and if there are such critics we may say of them and their criticisms that "fools rush in where angels fear to tread."

As I said at the outset, I wish, in all I have said, to be counted as an outsider and an expert, called in to pass judgment upon the work of your Station in the past. I can not too highly commend the comprehensive wisdom of the statute which established your Station "*for the purpose*," as it states, "*of promoting every branch of agriculture by scientific investigation and experiment.*" Mark the words. For a century hence no better law could be framed for such a purpose. I can not too highly commend the intelligence, faithfulness and zeal with which, under the director of your Station, this law has been carried out.

What, then, is the matter? I will be very brief in giving my opinion. It appears to have been unrecognized that such an institution as you established seven years ago was, and could only be, if successful, a growing institution; and that in its development it would demand, and must have, the means of development; and that, in short, means more money. It was a grave mistake that an institution doing such excellent work should not have reached out into other fields of useful effort, which in the very nature of the case it must occupy, or they must be permanently neglected.

Stimulated perhaps by the just demands of the farming community, and yet in accord with their judgment, the board of control of your Station are, without exception, desirous of supplementing the work hitherto done, by entering upon other matters which demand and which will repay investigation.

To do this will require increased facilities, more men and more money, and neither should be withheld. It is contemplated in the future to extend the experimental work in the field, which has hitherto been confined to small plots, to the entire farm of 125 acres. It is proposed to enter into an exhaustive investigation for the purpose of determining the relative value of the various breeds of cattle for the purpose of the dairy or for beef; the relative cost of production of milk, butter, cheese and beef, and the food rations which, with greatest economy, secure the best results. It is proposed to have upon the ground of the Station a permanent exhibit of every kind of agricultural implement used upon the farm. It is proposed to have an arboretum, in which, in time, there shall be a permanent exhibit of every kind of tree and shrub which in this latitude may be successfully grown; it is proposed to have upon the grounds, for the purpose of comparison, all the new varieties of small fruits, and berries, and vegetables, in order that their relative value, under the same cultivation, may be determined; it is proposed to make a careful investigation of the many practical problems connected with one of our greatest industries — poultry.

In regard to the above, I would say that of my own personal knowledge, I am able to testify that without exception, so far as I know, the farmers, the various stock-breeders, the manufacturers of agricultural implements, the nurserymen and fruit-growers, and the poultrymen are unanimous in their desire to have this work entered upon and are ready to contribute, many, if not all of them, to supply the Station with choice animals and implements, and trees and fruits, and the material necessary with which to carry on this work.

It is hoped that there will be provided at the Station the means of securing protection to the farmers of the State in the purchase of fertilizers, for which there is at the present so large a demand and the use of which is so rapidly increasing. At the present we are mainly indebted to the supervision and control which our neighboring States are exercising upon this matter for the protection which we should secure for ourselves.

It appears most desirable that in the near future there should be established in several different sections of the State branch Experiment Stations for the purpose of determining the results which are produced by differences of soil or climate. Such work could and would be conducted by intelligent farmers in their several sections, under the direction and supervision of the central Station, and in this way the useful work and influence of the Station could be widely distributed at a very slight additional expense.

It appears desirable that provision be at once made for the erection of a suitable building for the reception and exhibition of such farm implements as have been or may soon be presented to the State, so soon as it is known that such will be received and cared for, as a nucleus of this permanent exhibition to which reference has been made.

It is desirable that this Station should be permanently provided with an adequate library of books of reference upon the various matters pertaining to agricultural science, and with the various appliances in the way of scientific apparatus necessary for the prosecution of its work; and while the slight additions to library and apparatus, which might from time to time be necessary, could be made from the annual appropriation, it is not sufficient to provide for the large outlay demanded for library and apparatus at the outset; and thus far the Station has largely depended for those upon the private property of its director.

I need not say that all these requirements for the present, or in the near future, will demand money, but I am confident that if very much more than we may ask for should be demanded to carry these plans into execution, there is not a community of farmers, nor those engaged in any other pursuit in this State, which would not, upon a full presentation of the matter, unite in declaring it to be the most beneficial use which could be made of the public money. It should be understood that, year after year, as the legitimate work increases, as new fields of usefulness present themselves, and the reasonable demands of our agricultural citizens shall be laid upon the Station, that additional facilities for meeting such demands will be imperatively necessary.

In the judgment of the director and of the board of control of your Experiment Station, there is immediate demand for an appropriation, in round sum of ten thousand dollars ($10,000), and were an additional five thousand added to this amount, it could in their best judgment be most wisely expended in entering upon other portions of this work already indicated as desirable; for example, for two thousand dollars ($2,000), there could be provided a suitable building for the reception and exhibition of the agricultural implements already mentioned; and for the sum of three thousand dollars ($3,000), (to provide for salaries and traveling expenses of two efficient men), there could be established at least ten branch Experiment Stations in as many different localities in the State.

PETER COLLIER,
Director.

WM. W. WRIGHT,
GERRIT S. MILLER,
Committee of the Board of Control.

ALBANY, *April* 16, 1888.

THE AGRICULTURAL INTERESTS OF NEW YORK.

The following table, taken mainly from the annual report of the Department of Agriculture, will present approximately the extent of the agricultural interests of the State of New York, as represented by the amount and value of its products and other statistics of interest.

NEW YORK, 1886.

	Bushels.	Value.
Corn	22,426,000	$12,558,650 00
Wheat	11,093,000	9,318,120 00
Rye	2,890,000	1,705,100 00

	Bushels.	Value.
Oats	40,223,000	$14,078,050 00
Barley	7,712,000	4,704,320 00
Buckwheat	4,553,000	2,362,360 00
Potatoes	27,995,000	11,477,950 00
Tobacco, lbs	7,583,000	872,045 00
Hay, tons	5,418,677	58,250,778 00
		$115,327,283 00

Farm Animals of New York.

	Number.	Value.
Horses	674,018	$65,365,391 00
Mules	5,210	552,366 00
Cows	1,540,053	46,971,617 00
Oxen	851,128	27,164,603 00
Sheep	1,564,067	5,415,582 00
Hogs	686,390	5,803,084 00
	5,320,866	$151,272,643 00

Other Statistics of New York.

Farm animals	$151,272,643 00
Leading crops	115,327,283 00
Dairy products	44,000,000 00
Wine and grapes	9,000,000 00
Other products	41,000,000 00

The agricultural products of the State amount to at least $250,000,000 annually, and, as has been seen, are of the most diverse character. In fact, it is questionable whether an equal area upon the globe presents a greater diversity of soil, of climate and of agricultural interests than does the Empire State.

Not alone in name but in very fact, it is imperial, in its commanding influence and resources, its extent of territory, its commercial supremacy, foreign and domestic, its facilities for transportation, its fertile soil, its abundant products and its aggregate wealth.

It is surpassed but by two States in the aggregate value of the leading crops, but by two in the aggregate value of its farm animals, but by two in the number of its farms, and by no State in the Union in the number of farms which are cultivated by the owners of the farms.

Although but twenty per cent of its people are actively engaged in agriculture, the aggregate interests of this portion of the community are such as to demand, as they should receive, the most serious consideration.

While there is in the general intelligence which characterizes our agricultural methods much to encourage and give hope for the future, the possibilities of the future are far in advance of anything yet achieved except by those who are in the very fore front.

It is entirely within bounds of facts to assert that there are at least ten per cent of our farmers, in whatever branch of agricultural industry they may be engaged, who are getting double the return of the average of those engaged in that branch — twice the bushels per acre, twice the pounds of butter per cow, and this too simply by improved methods and intelligent application of the fundamental principles of success which should govern their practice.

Such facts sufficiently justify any remarkable expenditure which may aid in advancing our agriculture to a more productive and more prosperous condition.

The aid which experiment stations have rendered in bringing this about is now generally admitted, but their work has thus far been mainly limited to Great Britain and the Continent. In the United States there is reason to believe that the benefits will be as great to our agriculture and more speedily secured than in Europe, since we can build upon very broad foundations already carefully laid by these pioneers in scientific agriculture.

IS THE SOIL OF NEW YORK BEING EXHAUSTED OF FERTILITY?

The exhaustion of soils of those elements of fertility which are known to be removed in the several crops has been already so well established as to constitute one of the admitted facts of agricultural science. The means by which such exhaustion may be prevented, and by which even the fertility of the soils may be greatly increased, have also been in many cases equally well established.

It is obviously of the highest practical importance to determine how effective have been the means employed to maintain not only the fertility of the farming lands of New York, but of other States as well. The successful production of a crop depends upon so many conditions that the changes in the chemical and physical conditions of the soil can not easily be recognized without extending the comparison of products over long intervals of time and large areas of territory.

From the reports of the Department of Agriculture the following statistics have been compiled, giving the average yield of the several leading crops during the past quarter of a century; and for convenience of comparison the averages are given for three periods — from 1862 to 1869, inclusive; from 1870 to 1878, inclusive; and from 1879 to 1886, inclusive.

	1862-1869.	1870-1878.	1879-1886.	
Corn, bushels	29.7	33.1	29.6	99.7
Wheat, bushels	15.1	14.7	14.9	98.7
Rye, bushels	15.5	13.9	12.3	79.4
Oats, bushels	30.1	33.1	29.8	99.0
Barley, bushels	22.5	21.7	23.4	104.0
Buckwheat, bushels	19.3	18.2	14.1	73.1
Potatoes, bushels	103.8	91.3	81.3	78.3
Hay, pounds	2524.	2420.	2228.	88.3
Tobacco, pounds	896.	931.	1382.	154.3

The last column gives the percentage yield of the last period of eight years, and, as will be seen, the three principal cereal crops, wheat, corn and oats, have fallen off on an average less than one per cent, while barley, an important crop in our State, has increased in average yield four per cent.

The two crops which show a falling off which is noteworthy are potatoes and hay, while tobacco, which makes unusual demands upon the soil, has increased over fifty-four per cent in its average yield per acre.

The above record for New York will appear far more favorable when it is contrasted with that of several of the leading States of the west.

In 1886 the ten States, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska and California, produced 63.2 per cent of the corn crop of the United States, and 63.1 per cent of the wheat crop. Their crop of wheat had 60.3

per cent of the total value of the wheat crop of the United States, and 52.4 per cent of the value of the total corn crop.

The average acreage yield of these ten States during the thirteen years, 1862 to 1874 inclusive, was of wheat 13.95 bushels, and of corn 33.24 bushels; during the twelve years, 1875 to 1886 inclusive, the average acreage yield of wheat was 12.63 bushels, and of corn 30.84 bushels.

It appears, therefore, that these States had fallen off nearly ten per cent in their average yield of wheat, and over seven per cent in their average yield of corn, a condition of affairs which may justify a certain degree of anxiety lest these fertile fields of the west, which give us our excess for export, are, through unwise agricultural methods, being exhausted of their fertility to an extent which shall before long render the future production of these crops unprofitable to the farmer.

BULLETINS.

here has been a very general desire upon the part of the farmers of the State and other friends of the Station that the publication of occasional bulletins should be resumed, in order that the work of the Station should be made known more widely and at more frequent intervals than was possible by means of the annual report.

In accordance with this desire there have been issued by the Station six bulletins, in which the following subjects have been discussed or the results of the work of the Station set forth:

Bulletin No 10—*August*, 1888.

1. Influence of fertilizers on the chemical composition of plants.
2. Analysis of feeding stuffs.
3. Feeding and digestion experiments.

Bulletin No. 11—*September*, 1888.

1. Experiments in cultivation.
2. Experiments in root growth.
3. Experiments with fertilizers.
4. Experiments with insecticides.
5. Experiments with fungicides.
6. Experiments with the potato.
7. Experiments with sorghum.

Bulletin No. 12—*September*, 1888.

1. Digest of the fertilizer laws in several States.
2. Statistics of fertilizers.
3. The Maynard bill.

Bulletin No. 13 — *September*, 1888.

Farm and field experiments:
    Condition of the farm.
    Rotation of crops.
Field experiments on the farm, 1888:
    Oats, corn, grass.
    Discussion of results.
    Forage.
    To the farmers of New York.
Experimental plats:
    Grass plats.
    Fertilizer experiments
        On corn, on potatoes.
    Forage experiments begun on plats,
        With corn, with sorghum.
Branch experiment stations.

Bulletin No. 14—*October*, 1888.

Chemical composition of some feeding stuffs:

    1. Defining of terms.
    2. Grasses, clovers and forage crops.
    3. Grasses and by-products.
    4. Grasses of New York.

Bulletin No. 15—*November*, 1888.

Methods adopted for the systematic testing of new fruits.
A circular to the originators or proprietors of new fruits.
A list of fruits now under trial at the Station.

I have every reason to believe that the publication of these bulletins gives great satisfaction to the farmers of the State, and that they are almost invaluable in informing the people as to the work we have in hand, and of disseminating the results of our work.

Many of our agricultural papers have republished them in full for the benefit of their readers and there are received daily applications for them at the Station.

It is, however, a considerable expense to the Station to print and post them, and when we consider that nearly 380,000 of our citizens are directly engaged in agriculture, it will be seen that our resources do not permit us to reach but a small fraction of even one per cent of those who may be directly benefited from the result of our labors at the Station. Besides these bulletins there have been issued circulars setting forth the needs of the Station, the proposed plan for the thorough investigation of our several breeds of dairy cattle to determine their relative value for the dairy; and a plan to establish at the Station a permanent exhibition of all the agricultural tools and implements which are manufactured and sold for use upon the farm.

The publication of these bulletins and circulars has resulted in a very greatly increased interest in the plans and work of the Station as is shown by the great mass of correspondence elicited by this means, not a mail but which brings letters of inquiry as to details or making offers of aid in carrying out the plans contemplated.

More especially has this been the case in reference to the subjects of:

1. A fertilizer control being established at the Station.
2. The proposed tests of dairy cattle.
3. Branch Experiment Stations.
4. The poultry industry.
5. The permanent exhibition of tools and implements of agriculture.

1. THE CHEMICAL CONTROL OF FERTILIZERS.

The following bulletin was issued in reference to this matter, in which appears a

DIGEST OF THE FERTILIZER LAWS IN SEVERAL OF THE STATES.

Connecticut.

To all fertilizers retailing at ten dollars or more per ton the seller must affix a correct label and furnish to the director of the Experiment Station a certified statement of its composition and a sealed sample must be deposited by the manufacturers or importers with the director. The manufacturer or seller must deposit with the director of the experiment station *an analysis fee of ten dollars* for each fertilizing ingredient which the fertilizer contains. Every person who sells or acts as agent for the sale of any commercial fertilizer shall annually, or at the time of becoming such seller, report to the director of the experiment station his name, residence and post-office address, also the brand of fertilizers sold. No person or party shall sell in the State any pulverized leather, raw, steamed, roasted or in any form, as a fertilizer, or as an ingredient of any fertilizer or manure without explicit printed certificates of the fact being conspicuously affixed to every package. The director of the experiment station is authorized in person or by deputy to take samples for analysis.

Maine.

For the purpose of protection from frauds in commercial fertilizers and from adulteration in food, feeds and seeds the Maine Fertilizer Control and Experiment Station was established. It provides that to every package of commercial fertilizer, the price of which exceeds ten dollars, there shall be affixed a certificate stating the number of net pounds in the package, the name or trade-mark of the brand, the name of the manufacturer, the place of manufacture and a chemical analysis of the fertilizer. For the sale of such fertilizer annually, by April 1 a license must be procured by the manufacturer, company or person selling in the State, from the board of managers for the station. *A license fee of fifty dollars* for a single brand *and fifteen dollars* for each additional brand is required, and there must be furnished to the secretary of the board of managers the names of all the agents authorized to sell the fertilizer in the State. The director or his deputy is empowered to select annually fertilizers for analysis from these different packages, from three different sections of the State.

Massachusetts.

The new law, recently enacted in Massachusetts, provides that the manufacturer, importer, agent or seller shall, for any fertilizer which retails at more than ten dollars per ton, annually, before the first day of May, pay to the director of the experiment station an analysis fee of $5 for each of the three fertilizing ingredients—nitrogen, phosphoric acid and potash—claimed to exist in the brand. A printed statement must accompany each package giving the name and address of the manufacturer, also the chemical composition of the fertilizer. No person shall offer for sale any pulverized leather, raw, steamed, roasted or in any form as a fertilizer or ingredient of any fertilizer or manure without affixing a printed certificate of the fact to every package. The director shall cause one analysis or more annually to be made of each brand of fertilizer and the results are to be published monthly.

New Jersey.

Every commercial fertilizer offered for sale must be accompanied by an analysis and the method of stating the analysis is defined. The chemist of the State Board of Agriculture is the inspector of fertilizers and he must analyze annually one or more samples of every kind of fertilizer offered for sale. Any person interested may obtain an analysis, from the inspector, of any fertilizer, and for the certificate of analysis the parties must pay to the chemist a sum not exceeding fifteen dollars.

Pennsylvania.

The law specifies that every package of commercial fertilizer offered or exposed for sale in the State shall have plainly stamped thereon the name of the manufacturer, place of manufacture, net weight of contents, and an analysis stating the per cent. Every manufacturer or importer must annually file with the Secretary of the Commonwealth an affidavit stating the amount of said fertilizer sold within the State during the preceding year. It is the duty of the Board of Agriculture to analyze such specimens of commercial fertilizers as may be furnished by its agents.

The license fee required is $10 for every hundred tons sold, $20 for 100 to 500 tons, and $30 for above 500 tons.

North Carolina.

The law in this State requires that the manufacturer or seller procure a license from the State Treasurer for which he shall pay *a privilege tax of* $500 for each separate brand or quality offered for sale. There must be also affixed to every package of fertilizer a printed label setting forth the name, location and trade-mark of the manufacturer, also the chemical composition of the contents of each package. The Department of Agriculture may require the officers, agents or managers of any railroad or steamboat company to furnish monthly statements of the quantity of fertilizer, with the name of the consignor or consignee, delivered to any point in the State. They may even compel the company to submit their books for examination.

TABLE SHOWING STATES REQUIRING LICENSE, TAX, OR ANALYSIS FEE FOR SALE OF FERTILIZERS:

State.	Requirements.*	Amount required.
Connecticut	Analysis fee.	Ten dollars per ingredient.
Delaware	Analysis fee.	Thirty dollars to $40.
Georgia	Tax	Fifty cents per ton (for tags).
Indiana	Analysis fee.	Two dollars and $1 per 100 for tags.
Kentucky	Analysis fee.	Fifteen dollars and $1 per 100 for tags.
Louisiana	Tax	Fifty cents per ton.
Maryland	License	Five dollars first 100 tons, $2 for each additional 100 tons.
Maine	License	Fifty dollars first brand, $15 each additional brand.
Massachusetts	Analysis fee.	Five dollars for each ingredient.
Michigan	License	Twenty dollars per brand.
Mississippi	Analysis fee.	Twenty dollars per brand.
New Hampshire,	License	Fifty dollars per brand.
North Carolina	Privilege tax,	Five hundred dollars per brand.
Ohio	License	Fifty dollars per brand.
Pennsylvania	License	Ten dollars for 100 tons, $20 for 100 to 500, and $30 above 500 tons.
Rhode Island	License	Twenty-five dollars.
South Carolina	Tax	Twenty-five cents per ton (for tags).
Tennessee	Tax	Fifty cents per ton.
Vermont	License	Fifty dollars.

In a few of the States the number of analyses made for the past year are given, and so far as known they are given below:

	Number analyses.
Massachusetts	110
Maine	86
Connecticut	291
New Jersey	150
Pennsylvania†	
North Carolina	223
Georgia	413
Alabama	186

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* Recent legislative enactments may have slightly modified the law in some States.

† The analyses of 226 substances are given in the report for 1886, but the total number of analyses made is above 400.

The tables just presented show that nearly every State using commercial fertilizers to any extent, except New York, requires either a license to be taken out by the manufacturer or seller for the sale of commercial fertilizers, or that an analysis fee be deposited with the proper official.

In the South a tax is levied upon the fertilizer of twenty-five to fifty cents per ton, and in Georgia the tax amounts to more than $100,000 annually. The analysis fee or license ranges from five dollars or more in Maryland to fifty dollars per brand in several of the States, while in North Carolina it is $500.

While these other States give protection to the farmers against fraud in commercial fertilizers, and provide for their analysis, New York, whose farmers are expending fully $3,000,000 annually for commercial fertilizers, are left to provide their own protection and take their chances of receiving what they pay for.

Fortunately for the farmer, the majority of the manufacturers of commercial fertilizers are sincere in their efforts to put upon the markets goods which shall be all that is claimed for them. There are those, however, who by using misleading terms in their analyses, terms with which all the farmers are not familiar, are no less guilty of intentional fraud than was the manufacturer of Mason's High Grade fertilizer which was analyzed in 1885 at the New York Agricultural Experiment Station and found to contain one dollar and fifty-two cents worth of fertilizing ingredients per ton, and yet this fertilizer was being sold at thirty dollars per ton to the farmers throughout this State. There are other fertilizers sold the present season in the State of New York which have fallen considerably below the guaranteed analysis.

The following statistics copied from the United States census of 1880 will show the magnitude of this industry in several of the States. Only those are included the sales of which aggregate over $400,000 annually:

	Cash value of commercial fertilizers.
Alabama	$1,200,956
Connecticut	497,448
Delaware	467,228
Georgia	4,346,920
Maryland	2,838,465
Massachusetts	653,422
New Jersey	1,601,609
New York	2,715,477

	Cash value of commercial fertilizers.
North Carolina	$2,111,767
Ohio	550,029
Pennsylvania	3,525,336
South Carolina	2,659,969
Virginia	2,137,283
	$25,305,909

In connection with this matter the following statement is of interest:

Professor George H. Cook, director of the New Jersey Agricultural Experiment Station, says recently: "The weakness of human nature is such that nothing but the chemist's tests and publication are sufficient to hold the dealers to the furnishing of goods of standard purity. More than 40,000 tons of commercial fertilizers were used in our State last year, which were sold for considerably more than a million dollars, and the amount used in the whole United States is more than a million tons annually. Of the quality of these the farmer can form no judgment from their color, smell or taste, or their general appearance. The analysis and publication of the composition of these fertilizers has a most salutary effect. Honest manufacturers are protected and careless ones are held to their guarantees. Occasionally a brand of fertilizer of worthless character is put upon the market. We lately had one which was sold for forty-five dollars a ton. This was an extreme and unusual case, but it suffices to show the importance of a careful control of the trade in such articles by an experiment station."

Testimony similar to the above may be furnished without limit. Indeed it is practically the unanimous opinions of all those who have given any consideration to this important subject.

The following bill was introduced into the Assembly at the last session of the Legislature by the Hon. Mr. Maynard on the 15th of March, 1888, read twice and by unanimous consent ordered to a third reading and printed:

AN ACT to prevent fraud in the manufacture and sale of commercial fertilizers, and to provide for a chemical analysis of the same.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. Before any commercial fertilizer or manure, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the manufacturer, importer, or party who causes it to be sold or offered for sale within this State shall file with the director of the New York Agricultural Experiment Station one certified copy of the certificate now required by section one of chapter two hundred and twenty-two of the laws of eighteen hundred and seventy-eight, to be affixed to each package of fertilizer or manure so offered for sale in this State, and shall deposit with said director a sealed glass jar or bottle containing not less than one pound of the fertilizer or manure, accompanied by an affidavit that it is a fair average sample thereof; but only one certificate and affidavit need be filed, and but one sample deposited.

§ 2. The manufacturer, importer, agent or seller of any commercial fertilizer or manure, the retail price of which is ten dollars or more per ton, shall pay, on or before the first day of May annually, to the director of the New York Agricultural Experiment Station, an analysis fee of ten dollars for each of the fertilizing ingredients contained or claimed to be contained in said fertilizer or manure; provided, that when the manufacturer, importer or other person shall have paid the fee herein required, no agent or seller be required to pay the fee named in this section. For any violation of this section the offender shall be liable to a penalty of $200, to be sued for by the director of the New York Agricultural Experiment Station, the recovery to go to the State.

§ 3. Every person in this State who sells or acts as local agent for the sale of any commercial fertilizer or manure, of whatever kind or price, shall, at the time of becoming such seller or agent, and annually thereafter, so long as he shall so act, report to the director of the New York Agricultural Experiment Station his name, residence, post-office address and the name and brand of said fertilizer or manure, with the name and address of the manufacturer, importer, or party from which such fertilizer or manure was obtained; and shall, on demand of the director of the New York Agricultural Experiment Station, deliver to said director a sample suitable for analysis, of any such fertilizer or manure then and there sold or offered for sale by such seller or agent. Any persons violating the provisions of this section shall be liable to a penalty of ten dollars, to be recovered by action by any person to whom said fertilizer or manure shall be sold.

§ 4. Violations of section one of this act are misdemeanors, and on conviction the punishment shall be, for the first offense, a fine of not less than $100; and for the second offense, a fine not less than $200.

§ 5. The director of the New York Agricultural Experiment Station shall pay the analysis fees received by him into the treasury of the State, and shall cause one or more analyses of each fertilizer or manure to be made and published annually, and shall mail at least one copy of such published analysis to each agent or seller of said fertilizer or manure, who shall have reported to him, as provided in section 3 of this act. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of fertilizer or manure which may be in possession of any agent or seller.

§ 6. This act shall take effect on the first day of August, 1888.

The above act was amended so as to include ashes and to provide that only the excess of fees over the expenses incurred in carrying out the provisions of the bill should be paid into the State reasury.

A circular letter dated New York, April 5, 1888, was signed by nearly every leading manufacturer and dealer in fertilizers doing business in this State, and sent to the members of the Senate and Assembly, earnestly protesting against the passage of the bill, which they characterized as "a tax which is unjust and a direct blow against the farming industry of this State." The protest closes by saying: "We trust the enacting clause will be stricken out, and the bill consigned to oblivion." It is noticeable that this protest in behalf of the farmers did not receive the signature of a single farmer. It will be seen that this bill which received this earnest protest was entirely reasonable as compared with similar enactments which have received the sanction of neighboring States.

The farmers and their friends throughout the State should see to it that the next Legislature should speedily pass a bill such as, or similar to, the Maynard Bill, and thus protect their interests in this important matter of commercial fertilizers, "so that our farmers may purchase these with the same confidence that they do sugar and nails and cloth."

The following modification of the "Maynard Bill" was agreed upon at a conference between a number of manufacturers of fertilizers and the friends of the bill, but so near the close of the session that it failed to pass:

AN ACT to prevent fraud in the manufacture and sale of commercial fertilizers, and to provide for a chemical analysis of the same.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. Before any commercial fertilizer, ashes or manure, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the manufacturer, importer or party who causes it to be sold or offered for sale within the State, shall file with the director of the New York Agricultural Experiment Station, one certified copy of the certificate now required by section one of chapter two hundred and twenty-two of the Laws of eighteen hundred and seventy-eight, to be affixed to each package of fertilizer, ashes or manure so offered for sale in this State, and deposit with the said director a sealed glass jar or bottle containing not less than one pound of the fertilizer, ashes or manure, accompanied by an affidavit that it is a fair average sample thereof, but only one such certificate or affidavit need be filed, and but one sample deposited of each brand or kind of such fertilizer.

§ 2. Every person in this State who sells or acts as local agent for the sale of any commercial fertilizer, ashes or manure of whatever kind or price, shall, at the time of becoming such seller or agent, and annually thereafter so long as he shall act, report to the director of the New York Agricultural Experiment Station his name, residence, post-office address and the name and brand of said fertilizer, ashes or manure, with the name and address of the manufacturer, importer or party from whom such fertilizer, ashes or manure was obtained, and shall, on demand of the director, or his deputy, of the New York Agricultural Experiment Station, deliver to said director or his deputy, a sample suitable for analysis, of any such fertilizer, ashes or manure then and there sold or offered for sale by said seller or agent. Any person violating either of the provisions of this section shall be liable to a penalty of ten dollars for each offense, to be recovered by action by any person to whom said fertilizer, ashes or manure shall be sold.

§ 3. No person or party shall sell, or expose for sale, in the State of New York, any pulverized leather, raw, steamed or roasted, or in any form, as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicitly printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany or go with every parcel or lot of the same.

§ 4. Violations of sections one and three of this act are misdemeanors, and on conviction, the punishment shall be for the first offense a fine of $100, and for the second or any subsequent offense, a fine of $200.

§ 5. The director of the New York Agricultural Experiment Station shall cause one or more analyses of each fertilizer, ashes or manure to be made and published annually, and shall mail at least one copy of such published analysis to each agent or seller of said fertilizer, ashes or manure, who shall have reported to him as provided in section (2) two of this act. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of fertilizer, ashes or manure which may be in possession of any agent or seller.

§ 6. This act shall take effect the first day of February, eighteen hundred and eighty-nine.

It will be observed, however, that in this amended bill there is an important omission, since no provision is made for defraying the inevitable expense attending the carrying of the law into effect. There appears to be a growing sentiment that such provision should be made by the State, and not rest as a tax upon the manufacturer or consumer of fertilizers. In regard to the expense attending this work, Dr. Cook, director of the New Jersey Experiment Station, says, in speaking of the fertilizer control stations in connection with the Hatch Experiment Station Bill, which appropriates $15,000 annually to each State: "The demand for such fertilizer control is sufficient to occupy the full force of a Station of the size contemplated by the Experiment Station Law." Dr. Cook, who has for a long time had this matter under his control in New Jersey, is a competent witness as to the necessary expense involved in the conduct of such fertilizer control station, and it is to be understood that he speaks from his experience in New Jersey, where the State provides by appropriation for the expense connected with this work. It is hardly to be presumed that the expense of the same work in New York will be proportioned to the relative size of the two States, but it is well to compare the two in considering the needs of our State for this purpose. New Jersey has an area of 7,815 square miles, while New York has an area of 49,170. The number of farms in New Jersey is 34,307; in New York, 241,058. The number of farmers in New Jersey is 22,672; in New York, 241,507. The number of those engaged in agriculture in New Jersey is 59,214; in New York, 377,460. In this connection it will be necessary to consider the need of provision for a chemical laboratory suitable for the carrying on of this proposed work, and I would mention a portion of an act passed by the Senate and General Assembly of the State of New Jersey, approved April 23, 1888: "Be it enacted (etc.) that the sum of thirty thousand dollars be and hereby is appropriated for the construction of a State laboratory for the Agricultural

Experiment Station under the direction of the board of managers of the State Agricultural Experiment Station." An appropriation, therefore, sufficient to carry on this work of the Station, as also for the construction of a suitable laboratory, would become an immediate necessity if such a bill as is contemplated should be enacted by the Legislature.

Of course, since a careful chemical analysis can alone tell whether a given fertilizer is really of any value or not, there was in the earlier years of this industry room for the most gigantic frauds, and often there were found upon the market so-called fertilizers hardly worth the bags in which the stuff was packed.

But of late years, owing to the chemical control which has been exercised over the sale of these products, their quality has steadily improved, and at the same time, owing to economy in their manufacture, the price has declined, so that at the present frauds are rare and the farmer in most cases is pretty sure of getting the worth of his money when he has need to add to the supply of fertilizing material which he is able to produce upon the farm.

The following table will show the improvement which has been made in commercial fertilizers in twenty years:

IMPROVEMENT IN FERTILIZERS.

YEAR.	Number analyzed.	Chemist.	Aver. market price.	Average value.	Average per cent of vul'e to cost.
1868	16	Johnson	$59 47	$21 36	36
1870	15	Bruckner	50 07	17 60	35
1871	11	Storer	56 36	36 32	64
1872	36	Collier	63 52	42 56	67
1881	36	Dabney	37 40	33 26	89
1888	212	Genth	30 03	27 96	93

From the above it will be seen that the average value has increased in twenty years thirty-one per cent; and that the average cost has decreased during the same period fifty per cent, or, in other words, the average saving amounts to 61.43 per cent, *i. e.*, the farmer can to-day purchase the same amount of fertilizing material for thirty-eight dollars and fifty-seven cents which would have cost him $100 twenty years ago, and this great reduction is largely due to the careful chemical control which has been exercised over this matter.

PROPOSED INVESTIGATION OF THE BREEDS OF DAIRY CATTLE.

Shortly after taking charge of the work at the Station I had the following bulletin published and sent to many of the leading dairymen and breeders of the State; in every instance it met with cordial approval and assurances of sympathy and coöperation with the Station in its efforts to carry forward this investigation:

New York Agricultural Experiment Station.

Upon assuming the directorship of this Station, it has occurred to me that there was a wide field for careful scientific investigation which could not but prove of immense practical value to the agricultural interests of the State, and especially the dairy interest, which I need not inform you is of almost preëminent importance to our people.

I beg leave to submit to your consideration the following points which have occurred to me, and shall be happy to receive from you any suggestions by way of criticism of the plan proposed, or of amplification of the details of the proposed investigation.

I shall be pleased to have your suggestions as to how I may secure most economically for the Station the animals needed for the purpose of such investigation and experiments, and any information which shall tend to make the results of the highest value to the people of the State.

1. At a public institution devoted to the advancement of agriculture through experimentation, the stock should be representative animals of the breed from which they are selected.

2. The dairy interest in New York State being the most important branch of the stock industry, it should be the first to receive attention.

3. The average butter yield per cow in this State does not exceed 130 pounds per year, whereas it should not fall below 300 pounds. This being true, the Station could do no better service for the dairymen of the State than to unite with them in working out the problems of feeding, individual variations and breed characteristics, with the allied subjects, which, when better understood and practiced, shall help to raise the standard and bring the yield up to double the present amount.

4. The breeds which should first be selected are the Jersey, Holstein, Guernsey, Ayrshire, Shorthorns, Devon, and one or two of the polled breeds.

5. In building up a herd to be used in experimental work young animals should be selected, animals under one year, or better, but a few months old. By having young animals, under like feeding, they can be grown to maturity, making the conditions for all the same, so that experiments with these animals would be much more valuable and conclusive than if their earlier feeding and environments had been widely different.

6. The yearly growth of the animals under like conditions and feeding, and the amount of food consumed for the several breeds in proportion to their live weight, is of value and importance to the dairyman, and would form a part of the trial.

7. At least four animals of each breed should be had, two heifers and two steers. The two heifers from each breed would be the beginning for a herd, finally enabling us to study the breed characteristics in production of milk and butter. Two steers from each breed fed and grown to maturity and fattened would show much as to the relative values of the dairy breeds for beef.

8. The question, which is the more profitable for the dairy, a small cow or a large one, is of much importance, and what place is better fitted to investigate this subject than an experiment station?

9. Whether with two foods of similar composition both will affect equally the milk and butter yield, or whether one will tend more to the production of body fat and less to an increase of milk.

10. The influence of the various grains fed separately and combined in rations, and to what extent the chemical and physical properties of butter are influenced by different foods.

I have but briefly indicated the general scope of the proposed investigation, but I can not but think it will meet your entire approval and receive your coöperation and that of your associates in this important branch of our agricultural industry.

At the annual meeting of the Holstein-Friesian Association, held shortly after the publication of the above proposed investigation at Buffalo, March twenty-first, Mr. E. A. Powell submitted the matter to the association and spoke in hearty approval of the plan, and the subject was discussed as follows:

MR. POWELL.—I will say that the scope of the experiments is broad; it takes in nearly everything—or is intended to take in everything—for which a breed of cattle is used. It seems to me that we have a breed of cattle that is better adapted to make a fine showing in that respect than any other. I also feel that experiments in this line will be of greater value than almost any others that can be made with any breed of cattle. This matter has been brought to our attention before it has been acted upon by any of the other associations, and it seems to me that prompt and favorable action on the part of this body would tend to place us before that institution in a favorable light, showing our hearty coöperation, and we would not fail to get a fair and just, and it seems to me a valuable, report, which would be to the advantage of our breed, providing we can furnish the right animals. The important thing to be considered is the kind of animals we shall furnish. He does not ask us to contribute any animals, but he asks us in what manner animals may be obtained by the Experiment Station at the least possible expense. If it is left for those gentlemen to purchase their own cattle, I am afraid they will not purchase as judiciously as it is for the interest of this association to have it done, and it seems to me proper to refer this matter to the board of officers, to make such selection of animals as they deem best; for instance, two animals for beef purposes, adapted to that particular purpose; and instead of two females, I would suggest four, and let the proposition be made with the understanding that we comply with this. We make a report to them that we will furnish four females and two males, providing any four other breeds of those mentioned by him will do the same. That would be my idea of making the report.

Mr. Yeomans.— I think the interest of the association would be better served to have the number not less than four, and, perhaps, if the board of officers have charge, they might say four, more or less, and I would suggest that if there are no competitors there, it would be almost folly to send animals and have to pay for them; but if there are two or more breeds willing to come in as competitors — not necessarily four, but two or more — I would favor it.

The President.— As the chair understands the motion of Mr. Powell, and the remarks which have followed it, the question before us is that the association is ready to enter into competition with any other breeds that may be sent there. Are you ready for the question?

The question was called for, and carried as stated by the president.

Recently the American Jersey Cattle Club, of New York, have agreed to select, through a committee, four females of their breed, which are to be presented to the New York Agricultural Experiment Station for the proposed test; and I have assurances that representatives of the Guernsey cattle will be selected for such purpose with equal care.

It is hoped that other associations, or leading breeders, may, by their action, unite with the Holstein-Friesian, Jersey and Guernsey Associations in providing the Station with such animals as may be wanted for the purpose of this investigation, and it is desired that any suggestions which may help to make the proposed investigation most satisfactory and complete will be sent to the director at any time.

While the greatest care will be exercised in the selection and purchase of representatives of the several breeds which we may desire, but which may not be furnished, it is obvious, as suggested by Mr. Powell, that a better selection can be made by select committees of the several associations than is possible by any other means.

It is intended to be ready for the reception of the animals by January 1, 1889, as the new barn necessary for the purpose of furnishing appropriate accommodations for these animals, and for which an appropriation was made, will be then completed. It has been largely planned for the express purpose of carrying forward the proposed investigation, and is believed to be admirably adapted to the purpose.

WATER SUPPLY FOR THIS STATION.

In planning for a new barn and the large increase of stock upon the farm which is contemplated, the question of a sufficient water supply became of great importance, and led to a careful survey of the land from which the supply for the Station has been hitherto secured, to determine whether an increased amount could be relied upon for the future.

Fortunately, the result of our explorations left no room to doubt that, with increased storage capacity at the fountain head, a sufficient supply may be had for future wants, and new pipes have been put in place of tile which had become worthless, and a new and much larger reservoir for the storage of water has been built connecting with the smaller reservoir from which the water is conveyed to the Station, and there appears now no reason to doubt that a supply of water has been secured amply sufficient for our future wants.

BRANCH STATIONS.

In a State embracing so wide an extent of territory as does the Empire State, with its differences of soil and climate, and with such great diversity of agricultural interests, it must naturally appear that any Experiment Station, wherever located, is largely a local institution, and that its results, however valuable and however clearly established, are necessarily limited to the conditions obtaining at the locality where such experiments are being conducted.

It is true that the farm belonging to the Agricultural Experiment Station closely resembles in character of soil many thousands of farms within the State, it being mainly composed of clay, clay and gravelly clay loam, so that methods of culture here found best may be, almost without modification, applied to many other localities, and the results here obtained may be confidently predicted in such similar localities.

But in view of the fact that this is a State institution and its benefits may justly be demanded by every agricultural interest of the State, it appears most desirable that in the near future there should be established in several different sections of the State branch experiment stations for the purpose of determining the results which are produced by differences of soil and climate. Such work could and would be conducted by intelligent farmers in their several sections, under the direction and supervision of the central Station, and in this way the useful work and influence of the Station could be widely distributed at a very slight additional expense.

It would seem best that such branch stations should be under the immediate supervision of local boards of control, who would themselves best select the one most intelligent and most in sympathy with the work to carry out the several experiments undertaken at these several branch stations, and who would thus feel a greater degree of personal responsibility for its thorough conduct.

The director will very gladly enter into correspondence with parties and especially agricultural societies in the several sections of the State, through which some such plan as is above outlined may be perfected and carried into execution.

It is said that there are to-day in the German Empire alone 184 agricultural experiment stations engaged in the promotion of every branch of agriculture. It would seem that as many as ten branch stations could find profitable employment in the solution of the numerous problems which are presenting themselves in the many and various fields of agricultural industry of our Empire State.

The above appeared in a recent bulletin sent out by the Station and has met with very general favor both in this and other States.

The plan suggested appeared to be so desirable that in response to letters addressed to them by an enterprising agricultural editor, both the candidates for Governor in our late election declared their approval of the plan proposed and their willingness to favor it.

Many inquiries and suggestions have been received from various sections of the State, which give evidence of an intelligent appreciation of the practical and scientific value of such branch Stations, and an earnest desire to secure the advantages which the location of one in their section of the State would bring them.

THE POULTRY INDUSTRY.

The *Fancier's Review*, November, 1888, prints the following from the Bureau of Statistics of the Treasury Department:

Eggs Imported into the United States.

YEAR.	Dozens.	Value.	Price per dozen, cts.
1876	4,903,771	$630,393	13.0
1877	5,048,271	617,622	12.2
1878	6,053,649	726,037	12.0
1879	6,022,506	646,735	11.0
1880	7,773,492	901,932	11.7
1881	9,578,071	1,206,067	12.6
1882	11,929,355	1,808,585	15.1
1883	15,279,065	2,677,604	17.5
1884	16,487,204	2,677,360	16.2
1885	16,098,450	2,476,672	15.4

It is stated that there are annually consumed in the United States $200,000,000 worth of eggs, and that in the two weeks from April 7 to 19, 1884, there were received in New York city 78,667 barrels of eggs, containing 66,980,080 eggs.

The poultry product of the country for the year 1882 was said to far exceed in value either the wheat, hay, or cotton crops, or the aggregate products of the dairy, the figures being as follows:

Poultry products	$560,000,000
Wheat	488,000,000
Hay	436,000,000
Cotton	410,000,000
Dairy products	254,000,000

According to the census of 1880, there was, June 1, 1880, an aggregate of "poultry on hand, exclusive of spring hatching:"

Barn-yard fowls in United States	102,272,135
Barn-yard fowls in New York	6,448,886
Other fowls in United States	23,235,187
Other fowls in New York	496,406

There were produced of eggs in 1879:

	Dozens.
In the United States	456,910,916
In New York	31,958,739

The "orchard products of all kinds sold or consumed in 1879" were as follows:

In the United States	$50,876,154
In New York	8,409,794

The "market garden products sold in 1879" were as follows:

In the United States	$21,761,250
In New York	4,211,642

The "population in 1880" was:

In the United States	50,155,783
In New York	5,082,871

Of those "engaged in agriculture" there were:

		Per cent.
In the United States	7,670,493	=15.3
In New York	377,460	= 7.4

It needs but a glance at the above statistics to see that, whether considered absolutely or relatively, the poultry interest is one of great magnitude and importance, and well deserving no small share of our attention. It will be seen that New York had about six per cent of all the poultry, and produced over seven per cent of all the eggs produced in the United States.

It also appears that while the average production of eggs was sufficient to give a supply to each man, woman and child of over nine dozens (9.12) annually, the production in New York was equal only to an annual supply of a little over six dozens (6.29), so that the ratio of our demand was far in excess of the supply afforded by the State.

If, however, we compare the production of eggs to that portion of the people engaged in agriculture, we find that there were produced in the United States sixty dozens of eggs to every person engaged in agriculture, while in the State of New York there were eighty-five dozen produced annually to every person employed in agriculture, so that in proportion to our farming population the production of eggs in the State is far greater than is the average for the whole country.

" It is not a little strange that," remarks one of our leading poultry papers "in the establishment of agricultural experiment stations, the poultry industry should have been so utterly ignored. Were it an unimportant branch of agriculture, were the value of poultry products comparatively small, it would have been different; but as every one knows, their value stands second to scarcely any product of the farm, and, therefore, its title to recognition by our State experimental institution is apparent.

"The wonderful development of the poultry industry during the past decade is not greater than it will be during the next, and such experimentation as we suggest would be of vast benefit to the fancier and farmer."

In consideration of the importance of this subject, as also of the very general interest felt, as manifested by the excellent and extensive exhibits made throughout the State at many fairs and poultry shows, it has been thought well to begin a series of investigations, so far as our limited means would permit, looking mainly if not exclusively to the solution of the many practical questions relating to this industry, since the breeders and fanciers may be trusted to pursue with greater facilities questions which concern rather fancy points, of scientific interest and value beyond doubt, but not so fruitful in immediate practical results.

It is somewhat remarkable that the extended literature of this branch of agriculture contains so little which is reliable, based upon carefully ascertained and recorded facts.

There is a wide field for careful investigation in the matter of feeding, promising results of practical value quite in accord with those ascertained in the many experiments with other animals, and it will be seen by consulting the report of work already done in this direction by the first assistant that the results thus far secured possess a practical and a scientific value, and indicate other results of still greater interest only awaiting careful investigation to be determined.

It is desirable that better provision be made for extending and continuing this branch of our work at the Station.

BARN-YARD MANURE.

In order to properly understand the composition and value of barn-yard manure, it is necessary to consider the function of food in the animal economy.

In addition to supplying the material for the development of the body of the growing animal, food furnishes, through its consumption within the body, the animal heat and muscular force, supplying also the material to make good the constant waste of bony and muscular tissue.

A large portion of the food, depending upon the quality and quantity furnished the animal, remains undigested, and therefore unassimilated, and being thrown off constitutes the bulk of stable manure. The waste tissue of the body is eliminated mainly by the kidneys, and constitutes the liquid portion of manure, and since this is in a soluble condition, it is readily appropriated as food by the growing plant, and representing as it does the waste of bone and muscle, it is found to consist largely of compounds of nitrogen and phosphorus, two of the most important elements of plant food, and two of the most valuable constituents of commercial fertilizers.

Farm economy, therefore, demands that every reasonable precaution should be taken to secure, as far as possible, this the most valuable portion of our stable manure.

In the arrangement of the new barn much care has been given to the method by which it is proposed to secure every pound of fertilizing material produced in the stables, and it is thought that this feature of construction alone will, as an example to be followed by our farmers, amply repay all expenses attending the construction of the barn.

Careful experiments made at the Station, and recorded in this report, prove that the liquid portion of the manure contains approximately the same amount of fertilizing material as the solid portion; but, in addition, the portion present in the liquid portion, as has been already stated, is in a condition rendering it immediately available to the growing crop. This portion which is so generally allowed to be wasted, through imperfect methods for its preservation, it is proposed to save completely.

The method proposed to effect this is the construction of a firm foundation of cobble and cement, sufficiently strong to withstand a heavy load being driven over it.

This rectangular foundation is to be slightly crowning in the center and surrounded at the border with a wide and shallow gutter. At each corner is to be located a cement cistern to receive from the gutter any leachings. This latter is wheeled out from the stable and piled upon the cement foundation.

The liquid manure from the stables is conveyed directly by vitrified tiling to those cisterns nearest the stables, and by means of a force pump this liquid portion may be from time to time thrown upon the pile of manure, or used directly for the fertilization of the gardens or fields.

In case of necessity, water, by means of a hydrant, may be applied to any portion of the pile to regulate the process of fermentation and prevent burning.

By this means it is intended to save every pound of the manure, and to preserve it in the best possible condition for application to the fields.

It is proposed also, in connection with this, to make careful investigation as to the amount saved, and the cost of construction of foundation, in order that our farmers may learn that it is a method within their means and worthy of their imitation.

A PERMANENT EXHIBITION OF AGRICULTURAL TOOLS AND IMPLEMENTS.

In considering the various methods by which the Experiment Station might be made more useful to the agricultural interests of the State, it has seemed desirable to *establish at the Station a permanent exhibition of all the agricultural tools and implements which are manufactured and sold for use upon the farm*—such an exhibition, only more complete, as is commonly made at our several town, county and State fairs.

It is obvious that manufacturers and dealers have found it to their advantage to go to the large expense involved in these annual exhibits, even though the time given by the farmers who assemble at such fairs is necessarily limited to a very brief examination into the merits of the many machines and tools submitted to their inspection. On the other hand, such an exhibition as is contemplated would enable the farmer wishing to purchase to visit the Station any day of the year and make thorough examination and comparison of such implements as he might wish to procure.

More than this, all such implements, machines or tools could be subjected at the Station to fair and impartial trials, by which their relative merits might be known, and such testimony would be invaluable to the farmer in enabling him to select the very thing best adapted to his special conditions.

It was contemplated to ask of the manufacturers only that they should consent to deposit at the Station, for the purpose of such exhibit, specimens of their machines, implements and tools, subject only to the condition that they should permit their being used at the Station, if thought desirable, for the purpose of determining by actual use their relative value for the purposes for which they were made.

The above plan has already, in general terms, been submitted to a few of our leading manufacturers, and has, without exception, commended itself to their judgment as a desirable feature to be connected with the Station; and all have offered to donate to the Station, for such purposes, their several machines so soon as we should be ready to receive them.

This statement was prepared in order that it might be submitted to the several manufacturers for the purpose of receiving from them any suggestions as to how such an exhibit might be made most useful, as also to learn how generally it may meet with their approval.

It is hoped that any manufacturer who favors it will at an early day inform the director of the Station whether he desires to contribute to such permanent exhibit, and whether he may wish to donate, or simply place upon deposit, his machines. It is desirable also to learn from each the weight and how much of floor-space is needed for the proper exhibition of such machinery, implements and tools as he may be willing to send.

So soon as a sufficient number of replies have been received as to promise the success of such permanent exhibition, the future details will be published.

SORGHUM SYRUP.

I desire to call attention to the analyses of the juices of several varieties of sorghum grown during the past season upon the Experiment farm. Although the season was unusually unfavorable to the full development of sugar in the plant, it will be seen that the average of several large samples taken from large plats showed close agreement in composition and contained, although the seed was only in the milk stage, an average of 9.55 per cent of cane sugar by analysis, and 9.64 by polarization. This is equal to the presence of twenty-one gallons of heavy syrup in each ton of cane.

It will be seen that certain varieties which ripened their seed contained much more sugar; ten analyses of canes being given in which there was an average of 11.74 per cent of cane sugar and 1.50 per cent of glucose in the juices.

Cane of this quality could be worked very profitably for sugar, but in this northerly latitude it will be found advisable to limit the manufacture to the production of syrup, which is already being produced in this section of excellent quality, and commands a ready sale at good pricees.

It would seem that several farmers could combine in establishing a suitable factory, and thereby greatly lessen the cost of manufacture, improve the quality of the product, and produce at good profits an abundant supply of excellent syrup.

Since my accession to the office of director, the Station has suffered another loss in its staff through the resignation of the assistant horticulturist, Mr. Beckwith, who left to take charge of the horticultural department of the Delaware Experiment Station, and in the language of my predecessor, in reference to the loss through promotion of Messrs. Arthur, Plumb and Babcock to other fields of labor, "this loss through promotion of so many members of our staff speaks volumes for the value of the Station as a training-ground." I also heartily indorse his remarks that "this Station deserves and should have the best talent, and should not allow superior inducements to deprive it of the services of efficient and growing investigators."

Another gratifying evidence of the position which this Station occupies in the judgment of those especially concerned in this work is seen in the fact that during the past year we have received many delegations from other Stations, recently organized under the bill for the establishment of agricultural experiment stations in the several States, for the purpose of investigating our plans and methods of work.

The State Grange also have, through their committee appointed for that purpose, made several calls upon us during the season, and have shown an active sympathy and an intelligent interest in the progress of our work, and the Station is most fortunate in having had from the first the friendly advice and coöperation of this numerous and influential portion of our agriculturists.

The same cordial feeling exists between the Station and the officers and members of the State Agricultural Society and the Dairymen's Association, and the director and some of the staff endeavor, so far as they may be able, to attend and participate in the farmers' institutes and meetings of the Dairymen's Association which are arousing such a lively interest and awakening such intelligent discussions among the farming people of our State.

Much of the work of the past season has been largely in the way of preparation for the new line of investigation which is laid out for the future; but, as will be seen in the reports which are hereby submitted, the work of past years has been carried forward so far as was possible with the diminished force of those engaged in it; and already a considerable portion of good work has been accomplished in the new fields of investigation into which it is intended to enter more largely in the future.

While it is beyond question true that often, and perhaps generally, the results of plat experiments are discordant and unsatisfactory, yet I think it is a matter of general experience among farmers that the application of fertilizing materials to the soil is productive of increased crops and justifies the practice. Indeed this is, I think, stating the case very mildly, for there are some who even hold that the amount of increase of crop may be confidently predicted in the majority of cases by the extent to which recourse is had to fertilizers.

It has seemed that by carefully selecting strips through cultivated fields, inequalities in composition and physical condition of soil could be largely avoided, and thus one source of error eliminated, and in fact the marked differences among parallel strips laid off on the Station farm .meadows and treated with different fertilizers were obvious to the most casual observer.

This fact was generally remarked by those inspecting the growing crops, and while any general rule of procedure for other sections and other seasons could not be laid down from such limited data, none could doubt that for such a season as the past, for that field and that crop, there were marked differences in product which could be due only to the fertilizers applied.

Or, to take another illustration, who can doubt that the great yield of potatoes secured in a recent contest, at the rate of 645 bushels to the acre of one variety, and 1,076 bushels of another variety, under the conditions of soil and climate obtaining in the locality where the trial was made, was due wholly to the fertilizers applied and the method of cultivation employed?

It is doubtless true that the above results may be less, equal or greater, in the same or another place and another season, and it is probably true that certain details in the trial of the past season might have been modified or omitted entirely without affecting the result recorded above; but I think none will doubt that with all the limitations and modifications which science would demand before accepting any conclusion from the trial, it does possess a decided value practically and scientifically which will be found helpful in the production of large crops in the future.

This matter is of such prime importance as a factor in determining the line of future experimentation, not only at our own but at other experiment stations of the country, that further consideration is warranted.

In all experimental work, and more especially in that environed with so many and often such intangible and uncontrollable conditions as are questions affecting agriculture, whether in the field, the feeding pens or the laboratory, it is eminently true that hasty generalizations are the very bane of science, and have been the occasion of endless ridicule, brought grave discredit upon what has been termed "book farming," and done much to hinder real advance.

It is true that many experiments have been made which seemed to prove, if they proved anything, that the application of stable manure was not only useless, but even harmful to the crop under trial; still does anyone believe that taking two farms regarded as equal in fertility, and treating one with the carefully husbanded manure produced upon it for a series of years, while the other should sell off crops and manure for a like period, the former would maintain or perhaps increase its original fertility, while the other would sooner or later show evidence of exhaustion in diminished crops? And yet such is but an experiment often tried, and concerning the practical and scientific lesson it teaches no one at the present day can have a doubt.

In brief, then, it is proposed at the Station to answer for our own fields the following question: "How can the farmer gain clear information about the richness or poverty of his soil in nitrogen, potash and phosphoric acid; or in other words, how can he determine the special need of manure of each of his fields?" And having, as we have confidence to believe we may, satisfactorily answered this question in our own case, we hope to be able to point out our method of securing this valuable information to the farmers of the State for their instruction and guidance.

It has seemed, therefore, wise to extend the size of our experiment plats; in fact, to put the entire fields and crops of the farm, so far as means will permit, under experiment, and while this will not prevent the growing of large crops we shall have, for example, instead of one crop of ten acres of oats or corn or wheat, ten or twenty crops of each, and the new barn has been built in part to provide for the separate storage of these several crops.

In this way it is intended not only to grow crops of grain, of forage and of roots sufficient for feeding the stock which it is intended to have in the future, but also to carry forward upon a more extended scale our various experiments in methods of fertilization and cultivation.

The climatic conditions prevailing during the past season have been almost if not entirely without precedent, and have seriously interfered with many of our experiments, which appear to have been wisely planned for ordinary conditions, but which have in many cases been without valuable results, as the records will show.

Indeed, a careful and complete meteorological record of the past year would fully explain and anticipate the results in the field, and this leads me to call attention to the importance of having this portion of the work at the Station fully provided for. Effort has been made to carry on these observations, as will be seen in this report, but there yet remains much more to be done in this direction, sufficient quite for the continuous employment of a trained observer and experimenter.

Few questions pertaining to agriculture are at the present time arousing greater interest among scientific men, or in their solution are likely to be of greater practical value to the farmer, than are those relating to the conditions of vegetable growth which are dependent upon soil temperature and moisture, and the means whereby these important conditions may be modified or controlled.

It is expected that the results which shall be secured by means of the four new lysimeters, which have recently been constructed and placed in position, may help materially in the solution of some of these problems.

GIFTS.

We are indebted to the publishers for the following list of newspapers and periodicals, which have been sent to us free of charge:

American Grocer, New York, N. Y.
American Cultivator, Boston, Mass.
American Rural Home, Rochester, N. Y.
American Poultry Yard, Hartford, Ct.
American Grange Bulletin, Cincinnati, Ohio.
American Farm News, Akron, Ohio.
American Analyst, New York, N. Y.
American Agriculturist, New York, N. Y.
American Farmer, Baltimore, Md.
American Garden, New York, N. Y.
Agricultural Epitomist, Indianapolis, Ind.
Canadian Horticulturist, Grimsby, Ontario, Canada.
Country Gentleman, Albany, N. Y.
Chicago Journal of Commerce, Chicago, Ill.
Chautauqua Farmer, Dunkirk, N. Y.
Delaware County Dairyman and Register, Franklin, N. Y.
Drug, Oil and Paint Reporter, Philadelphia, Pa.
Druggists' Bulletin, Detroit, Mich.
Delaware Farm and Home, Wilmington, Del.
Farm Journal, Philadelphia, Pa.
Farm and Home, Springfield, Mass.
Farmer and Breeder, Iowa City, Iowa.
Farmers' Home, Dayton, Ohio.

Farm, Field and Stockman, Chicago, Ill.
Farmer, St. Paul, Minn.
Farm and Fireside, Springfield, Ohio.
Fruit and Grape Grower, Charlottesville, Va.
Fanciers' Review, Chatham, N. Y.
Farmers' Advocate, London, Ontario, Canada.
Farmers' Review, Chicago, Ill.
Farmer's Club Journal, Hornellsville, N. Y.
Geneva Gazette, Geneva, N. Y.
Husbandman, Elmira, N. Y.
Household Companion, Boston, Mass.
Herds and Flocks, Chicago, Ill.
Holstein-Friesian Register, Brattleboro, Vt.
Hoard's Dairyman, Fort Atkinson, Wis.
Jersey Bulletin, Indianapolis, Ind.
Ladies' Home Companion, Philadelphia, Pa.
Maryland Farmer and New Farm, Baltimore, Md.
Mirror and Farmer, Manchester, N. H.
Massachusetts Ploughman, Boston, Mass.
National Live Stock Journal (weekly and monthly edition), Chicago, Ill.
National Farm and Fireside, Washington, D. C.
National Stockman and Farmer, Pittsburg, Pa.
Nebraska Farmer, Lincoln, Neb.
New England Homestead, Springfield, Mass.
New England Farmer, Boston, Mass.
New York Tribune, New York, N. Y.
New York World, New York, N. Y.
Orange Judd Farmer, Chicago, Ill.
Orange County Farmer, Port Jervis, N. Y.
Orchard and Garden, Little Silver, N. J.
Popular Gardening,Buffalo, N. Y.
Poultry Monthly, Albany, N. Y.
Peninsula Farmer, Federalsburg, Md.
Practical Farmer, Philadelphia, Pa.
Rural New Yorker, New York, N. Y.
Southern Cultivator, Atlanta, Ga.
Weekly Press, Philadelphia, Pa.
Wine and Fruit Grower, New York, N. Y.

We desire also to acknowledge the following gifts, for which the donors have our hearty thanks:

February 1. Of R. Shore, Cornell University greenhouses, Ithaca, N. Y., package of slips containing specimens of many species of greenhouse plants.

February 2. Of Daniel Batchelor, Utica, N. Y., four packages of vegetable novelties.

February 11. Of L. T. Sanders, Collingsburg, La., scions of Yellow Forest apple.

February 20. Of Daniel Batchelor, Utica, N. Y., package of seed of Momordica Charantia.

February 22. Of Prof. L. H. Bailey, Jr., Agricultural College, Mich., package of seeds of Ignotum tomato.

February 23. Of Dr. J. C. Arthur, LaFayette, Ind., slips of sixty named varieties of chrysanthemums.

February 24. Of Peter M. Gideon, Excelsior, Minn., cions of Low, Wealthy, August, Excelsior, September, Gideon, Martha and Peter apples.

February 28. Of Charles Sumner Jacobs, Medford, Mass., cions of Jacob's Winter Sweet apple.

February 28. Of Ephraim Link, Greenfield, Tenn., samples of two varieties of corn.

March 3. Of William Session, Geneva, N. Y., cions of five varieties of apples.

March 6. Of Iowa Agricultural College, Ames, Iowa, cions of ten varieties of plum; also cions of fifteen varieties of pear.

March 6. Dr. E. Lewis Sturtevant, South Framingham, Mass., two packets of peas from Cuba.

March 10. Of C. W. Garfield, Grand Rapids, Mich., ten reports of Michigan Horticultural Society for 1887.

March 12. Of C. O. Haven, Southport, N. Y., one package of kiln-dried Stowell's Evergreen sweet corn.

March 18. Of Whitney-Noyes Seed Company, Binghamton, N. Y., a quantity of choice and rare grass seeds.

March 19. Of Iowa Seed Company, Des Moines, Iowa, nine packets of vegetable seeds, a sample tuber of a new potato, and the privilege of selecting seeds from their catalogue free of cost.

March 19. Of Price & Reed, Albany, N. Y., five packets of vegetable seed.

March 19. Of A. W. Livingston's Sons, Columbus, Ohio, twenty-seven packets of vegetable seeds, and samples of a new potato.

March 19. Of Vilmorin-Andrieux et Cie, Paris, France, sixteen packets of vegetable seeds, and one variety of potato.

March 20. Of T. V. Munson, Denison, Texas, twelve varieties of grapes, two plants each, and three varieties of plums, two trees each.

March 22. Of W. Atlee Burpee & Co., Philadelphia, Pa., twelve plants of Louise strawberry.

March 26. Of Dr. E. Lewis Sturtevant, South Framingham, Mass., package of seed from Mexico, "Acelgas."

March 26. Of George W. Trowbridge, Glendale, Ohio, cions of three varieties of pears.

March 27. Of Ephraim Link, Greenville, Tenn., one package peas.

March 28. Of Merrell, Anthony & Co., Geneva, N. Y., cions of seven varieties of apples.

March 31. Of P. H. Foster, Babylon, N. Y., cions of Marshall and Van Cott pears, garden plants, and unnamed seedling strawberry.

March 31. Of A. B. Cleveland & Co., 47 Cortlandt street, New York, samples of five varieties of pea, and one of bean.

March 31. Of Sidney Tuttle & Co., Bloomington, Ill., root grafts and cions of Delaware Red Winter apple.

March 31. Of Wm. Parry, Parry, N. J., trees of two varieties of cherry, plants of two varieties of strawberry, plants of one variety of raspberry.

April 2. Of D. Landreth & Sons, Bristol, Pa., tubers of a wild potato from Colorado.

April 2. Of J. M. Paul, North Adams, Mass., cions of new seedling plum.

April 3. Of English Specialty and Novelty Seed Company, Newton-le-Willows, Lancashire, England, twenty-three packets of vegetable novelties; also tubers of Stachy's tuberifera.

April 3. Of Sherwood Harness Company, Syracuse, N. Y., one No. 2 steel harness.

April 4. Of Hugo Beyer, New London, Ia., fifteen packets of vegetable and novelty seeds.

April 6. S. L. Dagwell, Utica, N. Y., cuttings of three unnamed seedling gooseberries.

April 6. Of F. C. Biddle, Chadd's Ford, Pa., two trees each of Brandywine cherry and Triumph gooseberry.

April 6. Of Robert Manning, Boston, Mass., report of Massachusetts Horticultural Society, part 1, 1887.

April 6. Of J. M. Thorburn & Co., one tuber of Rural New Yorker No. 2 potato.

April 9. Of Geo. J. Kellogg, Janesville, Wis., cions of the following varieties of apples: Wolf River, McMahan White, Yellow Transparent, Northwestern Greening.

April 9. Of R. S. Cole, Harman's, Anne Arundel county, Md., plants of Hoffman's seedling strawberry.

April 9. Green's Nursery Company, Rochester, N. Y., twelve plants of Jessie strawberry.

April 9. Of F. P. Venable, Ph. D., Chapel Hill, N. C., journal of the Elisha Mitchell Scientific Society for 1883 to 1887 inclusive.

April 10. Of J. M. Ogle, Puyallup, Washington Territory, two plants each of Puyallup Mammoth gooseberry, Crystal gooseberry, Evergreen blackberry, Red huckleberry, Red Flowering currant.

April 11. Of J. F. LeClare, Brighton, N. Y., two plants of Moore's Diamond grape.

April 11. Of J. R. Hawkins, Mountainville, N. Y., six potted plants of Banquet strawberry.

April 11. Of Hemmingway's London Purple Company, 90 Water street, New York, N. Y., one keg (seventy-six pounds) London purple.

April 12. Of Peter M. Gideon, Excelsior, Minn., cions of the following varieties of apples: Russian No. 7, No. 30, Nos. 1, 2 and 3 Sweet, Gideon Sweet, Gracie, Late Duchess, Blood Red.

April 12. Of Stayman & Black, Leavenworth, Kan., plants of Jewell, Ideal, Standard, Daisy, Nos. 15, 18, 19, 26, 42 and 44 grape-vines.

April 13. Of A. J. Caywood & Son, Marlboro, N. Y., one plant of Little Blue grape.

April 16. Of A. G. Tillinghast, Padilla, Wash. Ter., three packages of cauliflower seed.

April 17. Of A. J. Caywood & Son, Marlboro, N. Y., one plant each of Duchess, Poughkeepsie, Meterny, Mabel, Nectar, No. 1, No. 16 Red, No. 50 Ulster; two plants each of White Seedling currant, Crystal White raspberry, Minnewaska blackberry; also cions of Comet pear.

April 17. Of J. W. Adams & Co., Springfield, Mass., twenty-five plants of Hampden strawberry.

April 17. Of VanVleck & Wheeler, Hart Lot, N. Y., two bags of grape and small fruit fertilizer, one bag winter and spring fertilizer, one bag potato fertilizer, one bag corn fertilizer, one sack lawn dressing.

April 18. Of Reuben C. Hart, West Torrington, Ct., plants of Pioneer red raspberry.

April 19. Of D. S. Marvin, Watertown, N. Y., cuttings of Nos. 1, 2, 3 and 4 grapes.

April 19. Of George W. Trowbridge, Glendale, Ohio, twelve plants Ivanhoe strawberry.

April 19. Of J. Wragg & Sons, Waukee, Iowa, two trees each of Wrag's cherry, Lithors Weisthal, and Loutovka.

April 19. Of Edward Gillett, Southwick, Mass., one package of Nelumbium Luteum roots.

April 19. Of D. S. Myers & Son, Bridgeville, Del., peach trees as follows: Two Myers Seedling, one Globe, one Rosier.

April 19. Of Daniel Batchelor, Utica, N. Y., three packages of grass seed.

April 20. Of George W. Trowbridge, Glendale, Ohio, twelve plants of Haverland strawberry.

April 22. Of John Nogle, Plymouth, Ohio, samples of Nogle, Governor Foraker, Mrs. Foraker, and Ohio Centennial potatoes.

April 23. Of Alfred Rose, Penn Yan, N. Y., samples of Ontario and Peruvian potatoes; also two plants of Ambrosia grape.

April 23. Of T. S. Hubbard & Co., Fredonia, N. Y., one vine each of forty-four varieties of grape.

April 23. Of Bronson & Hopkins, Geneva, N. Y., eight varieties of species of ornamental trees for arboretum.

April 23. Of Ellwanger & Barry, Rochester, N. Y., varieties as follows: Twenty-four pear, fourteen plum, sixteen peach, six apricot, three cherry, twenty-four apple, nine grape, three gooseberry, four raspberry, one currant.

April 24. Of George W. Trowbridge, Glendale, Ohio, twelve plants of Ohio strawberry.

April 24. Of Field Force Pump Company, one "graduating spray" nozzle for insecticide work.

April 24. Of Albertson & Hobbs, Bridgeport, Marion Co., Ind., two trees each of Indian apple and Robinson plum.

April 24. Of R. S. Johnston, Stockley, Del., nine varieties of peach, one tree of each.

April 25. Of J. M. Thorburn & Co., 15 John street, New York, N. Y., one package of Thorburn's Everbearing Seedling strawberry.

April 25. Of New Process Fertilizer Company, Hart Lot, N. Y., plants of Dawley strawberry.

April 25. Of Hallowell Brass Company, Lowell, Mass., two graduating spray nozzles for distributing insecticides.

April 28. Of Cleveland Nursery, Lakewood, Ohio, six plants each of Thompson's Early Pride raspberry, Thompson's Early Prolific raspberry, Thompson's Early Mammoth blackberry, and twenty-four plants of Haverland Seedling strawberry.

April 28. Of B. F. Stinger, Charlottesville, Ind., one vine of Aledo grape.

April 28. Of S. F. Leonard, 149 West Randolph street, Chicago, Ill., privilege of selection from his catalogue free of charge.

April 30. Of G. H. & J. H. Hale, South Glastonbury, Ct., six plants each of Carman, Hale's Early and Scarlet Gem raspberry.

April 30. Of T. H. Hoskins, Newport, Vt., cions of thirty-one varieties of apple.

April 30. Of Iowa Seed Company, Des Moines, Iowa, samples of Wide Awake, Bonanza and Windsor No. 1 potatoes.

April 30. Of J. T. Macumber, Grand Isle, Vt., cions of Tobias Black, Landon, Tobias Pippin, Juicy Sweet and Mosher Sweeting apple; Grand Isle, Dr. Hoskins, Refreshing, Little Gem pear; Golden Gage, Speckled Gage and Improved Green Gage, or Tobias Gage, plum; and of Champlain No. 2 and No. 3 raspberry.

April 30. Of Miss Cooledge, Phelps, N. Y., collection of chrysanthemums.

May 1. Of C. L. Van Dusen Nursery Company, Geneva, N. Y., cions of fifteen varieties of apple trees.

May 1. Of Selover & Atwood, Geneva, N. Y., one sample each of twenty-two species or varieties of ornamental and forest trees for arboretum.

May 2. Of W. & T. Smith, Geneva, N. Y., one sample each of sixteen species or varieties of ornamental and forest trees for arboretum.

May 3. Of R. G. Chase & Co., Geneva, N. Y., one sample each of ten species or varieties of ornamental and forest trees for arboretum; also cions of twenty-one varieties of apples, and one tree each of two varieties of apricot, three of cherry, seven of peach and one of plum.

May 3. Of Z. H. Harris, Rochester, N. Y., twelve plants Genesee raspberry.

May 3. Of P. M. Augur & Sons, Middlefield, Conn., twenty-four plants each of Jewell, Gold, Cardinal and No. 70 strawberry.

May 3. Of Ellwanger & Barry, Rochester, N. Y., cions of twenty-four varieties of apple; one first-class tree each of twenty-four varieties of pear, three of cherry, fourteen of plum, sixteen of peach, six of apricot; five plants each of seven varieties of blackberry, one of currant, three of gooseberry, four of raspberry; also one plant of the "Mills" grape.

May 5. Of E. W. Reid, Bridgeport, Ohio, twelve plants of the Carmichael strawberry.

May 5. Of Ellwanger & Barry, Rochester, N. Y., one sample each of nine varieties of grape vines.

May 5. Of T. C. Maxwell & Bros., Geneva, N. Y., one sample each of eighteen varieties or species of trees for aboretum.

May 7. Of C. L. VanDusen Nursery Company, Geneva, N. Y., one sample each of five varieties or species of trees for aboretum also one tree each of two varieties of cherry, one of quince, three of pear and six of plum.

May 7. Of J. A. Everitt & Co., Indianapolis, Ind., sample tuber of Dakota seedling potatato.

May 7. Of Lewis Roesch, Fredonia, N. Y., three vines of Rutland grape; three plants of a new seedling gooseberry.

May 7. Of Selover & Atwood, Geneva, N. Y., thirty-one specimen trees for arboretum.

May 7. Of S. D. Willard, Geneva, N. Y., one tree each of seven varieties of plum.

May 9. Of Smith & Keran, St. Catharine's, Ontario, Canada, two plants Pearl gooseberry; one Sanders No. 1 black currant, two Sanders No. 2 black currant and cions of Princess Louise apple.

May 9. Of A. M. Purdy, Palmyra, N. Y., six plants each of Bubach No. 5 Pineapple, Warfield's No. 2, Burt's Seedling, Haverland & Hoffman strawberries.

May 10. Of M. Farnsworth, Wellsville, O., plants of Farnsworth strawberry.

May 10. Of J. & J. L. Leonard, Iona, N. J., plants of new seedling strawberry.

May 10. Of Matthew Crawford, Cuyahoga Falls, O., plants of Crawford, Excelsior, Enhance and Farnsworth strawberry; also Ada raspberry.

May 10. Of T. G. Zane, Chew's Landing, Camden county, N. J., plants of Mammoth and Daisy strawberry.

May 10. Of Peter Henderson & Co., 35 Cortlandt street, New York, N. Y., plants of Henderson and Crimson Cluster strawberry.

May 11. Of Niagara White Grape Company, Lockport, N. Y., six Niagara grape vines.

May 11. Of W. H. Lightfoot, 535 Black avenue, N. Springfield, Ill., five plants Lincoln strawberry.

May 11. Of J. J. H. Gregory, Marblehead, Mass., sample tuber of a new seedling potato.

May 12. Of Chauncey Sheffield, Geneva, N. Y., fifty seedling trees each of the pear and plum, for stocks; also ten root grafts of the Arctic apple; and a quantity of peach pits.

May 14. Of William Lyons, Box 685, Minneapolis, Minn., six plants of a seedling strawberry.

May 14. Of Coe & Converse, Fort Atkinson, Wis., twenty-four plants of Spry's Early raspberry; also twelve Bubach and twelve Summit strawberry plants.

May 15. Of Parker & Wood, 49 North Market street, Boston, Mass., twelve plants of the Belmont strawberry.

May 16. Of Commissioner of Agriculture, Washington, D. C., cuttings of fifteen varieties or species of willow.

May 16. Of J. J. H. Gregory, Marblehead, Mass., one tuber of the Early Oxford potato.

May 17. Of A. DeB. Lovett, Geneva, N. Y., one Grasshopper hay tedder.

May 18. Of Wm. Henry Maule, Philadelphia, Pa., one package XX Dwarf beans.

May 19. Of Albert L. Dohles, Waterloo, N. Y., 150 choice pansies.

May 21. Of C. E. Angell, Oshkosh, Wis., tubers of seedling potato No. 79.

May 22. Of Prof. Magnus Swenson, Fort Scott, Kansas, one and one-half bushel of sorghum seed.

May 22. Of H. D. Woodruff, Auburn, N. Y., two tons soluble Pacific guano.

May 25. Of Charles Basom, Indian Falls, N. Y., one package of Tree beans.

May 36. Of R. Shore, Ithaca, N. Y., specimens of eighty-three fine greenhouse plants.

May 26. Of W. & T. Smith, through Wm. Baxter, Geneva, N. Y., twenty-four named varieties of dahlias.

May 28. Of the Zœktein Co., Albany, N. Y., package "Zœktein poison."

May 29. Of Chas. Waugh, Lodi, N. Y., seven varieties of seedling potatoes.

June 29. Of Swift Brothers, Millbrook, N. Y., one Swift's patent roller gate.

June 29. Of Riverhead Agricultural Works, Riverhead, N. Y., one Hudson Bicycle cultivator (two-horse).

July 26. Of W. F. Marks, Chapinville, N. Y., one Geer's "Common Sense" farm gate.

July 26. Of J. Broadfoot, gardener to Hon. S. H. Hammond, Geneva, N. Y., seedling primulas.

August 27. Of Luther Burbank, Santa Rosa, Cal., buds of two varieties of Japan plums.

September 8. Of Department of Agriculture, Washington, D. C., four packages of winter wheat.

September 8. Of Department of Agriculture, Washington, D. C., two packages of rye.

September 8. Of Van Vleck & Wheeler, Hart Lot, N. Y., two bags of fertilizer, special strength, for winter and spring grain.

September 20. Of J. Taylor Hunt, Romulus, N. Y., one peck White Seneca potatoes, for trial and seed.

September 25. Of Hill & Co., Richmond, Ind., collection of begonias and coleus.

October 6. Of Harry Smith, Geneva, N. Y., some very fine samples of seed corn.

October 12. Of Prof. W. J. Beal, Agricultural College, Mich., fifteen species of grass seed, comprising nine genera.

October 26. Of American Glucose Company, Buffalo, N. Y., 1,000 pounds of "dry feed No. 1."

October 26. Of Bronson & Hopkins, Geneva, N. Y., four packages of German grass seed.

October 27. Of S. L. Dagwell, Utica, N. Y., five plants No. 1 Seedling gooseberry.

October 27. Of Thomas Lewis, florist to W. & T. Smith, Geneva, N. Y., various green-house plants.

November 8. Of Chas. Carpenter, Kelley's Island, Ohio, plants of two new seedling raspberries.

REPORT OF THE FIRST ASSISTANT.*

The following report gives the results of the few experiments which we have been able to make in regard to poultry, sorghum, etc.

It is intended to continue experiments in poultry feeding as soon as better facilities in regard to buildings, yards and stock are secured.

POULTRY EXPERIMENTS.

The following preliminary experiments have been made. These were for the purpose of determining:

The approximate amount of food required for a fowl.

The average weight of eggs and loss of weight in keeping.

The difference in the composition of eggs in regard to proportion of the principal proximate constituents, and whether any difference is due to influence of food or of breed.

The specific gravity of eggs — of fresh eggs and of those kept for a time under the ordinary conditions.

It is a matter of regret that so few fowls were used in these experiments. But when the work was begun only sixteen were available, and after it was decided to continue the experiment, we were unable to obtain any more which would be comparable with these in matter of age and previous treatment.

Four pens of fowls were first fed to determine the amount of food consumed.

Pen No. 1 contained four Light Brahma Pullets.

Pen No. 2 contained four Laced Wyandotte pullets.

Pen No. 3 contained four S. C. W. Leghorn pullets.

Pen No. 4 contained four W. C. B. Polish pullets.

They were fed ground oats, moistened with water, in the morning; at noon, raw apples; and at night Indian corn, whole. Sometimes boiled potatoes were substituted for apples at noon. The oats, which were seasoned with salt and pepper, were weighed before and after mixing with water. The wet food contained from thirty to fifty per cent of added water; usually about forty. The amount not eaten was weighed, and the weight of wet food eaten was calculated back to dry weight. The portion of apples not readily eaten was weighed back. The same was done with corn.

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* William P. Wheeler.

A dish of water was kept in each pen.

The average weight of food consumed per day from January 23 to February 26 was:

	Ounces Indian corn.	Ounces raw apples.	Ounces ground oats.
Pens 1 and 2	24.48	18.53	10.12
Pens 3 and 4	11.86	12.53	3.74

Average one fowl:

	Ounces Indian corn.	Ounces raw apples.	Ounces ground oats.	Ounces total grain.	Ounces total food.
Larger breeds	3.06	2.32	1.27	4.33	6.65
Smaller breeds	1.48	1.57	.47	1.95	3.52

The apples contained eighty-four per cent of water and the boiled potatoes seventy-eight per cent.

The quantity of food was probably sufficient, as the fowls continually, although slowly, gained in weight. The weather at this time was very cold. From January 23 to February 20 the total gain was:

Pen No. 1, two pounds, fifteeen and a half ounces.

Pen No. 2, three pounds, eight and a half ounces.

Pen No. 3, one pound, four and a half ounces.

Pen No. 4, fifteen ounces.

None of these pullets were laying.

The weight of grain food consumed by the smaller breeds was forty-five per cent of the amount consumed by the larger breeds. In a later experiment, when the hens were laying, the amount consumed by the smaller was seventy-two per cent of that consumed by the larger.

On March 1, the fowls were arranged for a feeding experiment in which to observe the influence of different feed on the composition of the eggs. The four pens were as follows:

Pen No. 1 contained two Brahma and two Wyandotte pullets.
Pen No. 2 contained two Brahma and two Wyandotte pullets.
Pen No. 3 contained two Leghorn and two Poland pullets.
Pen No. 4 contained two Leghorn and two Poland pullets.

The fowls were of the breeds named, although considerably short of the standard. In regard to age and previous treatment, No. 1 was the same as No. 2, and No. 3 the same as No. 4.

The total weights were as follows on March 1:

No. 1, twenty-three pounds and ten and one-quarter ounces.
No. 2, twenty-four pounds and three-quarter ounces.
No. 3, twelve pounds and two and one-quarter ounces.
No. 4, twelve pounds and two and one-quarter ounces.

The space occupied by each pen was twenty-four feet long by six feet wide. One-half of the floor was covered with fine coal ashes; the remainder was earth floor. The open yards, attached, in which the fowls were allowed to run continuously after April 23, were each thirty-six feet long by six feet wide.

A box of ground oyster shells was kept in each pen and also a box of dry earth.

The experiment was continued for six months, from March 1 to September 1.

The feed for Nos. 1 and 3 contained a larger proportion of albuminoids than the feed for Nos. 2 and 4. Pens 1 and 3 were fed from a mixture of linseed meal and wheat bran in the morning, and wheat at night. Pens 2 and 4 were fed corn meal in the morning and wheat at night. For the first few months all the pens were also fed raw apples, and sometimes, instead, boiled potatoes at noon. They were fed all the meal that they would eat, but always much less wheat than they wanted. The amount consumed differed somewhat from week to week. The daily average, however, for each fowl was: for the larger breeds, about 1.4 ounces of the meal and 1.6 ounces of wheat; for the smaller breeds, about .9 ounce meal and 1.2 ounces wheat.

The average total food per day for the six months was for each fowl:

In Pen No. 1, 3.60 ounces.
In Pen No. 2, 3.60 ounces.
In Pen No. 3, 2.57 ounces.
In Pen No. 4, 2.55 ounces.

The average feed per one fowl for the entire period was:

	Linseed meal and bran.	Apples.	Potatoes.	Wheat.
	Ounces.	Ounces.	Ounces.	Ounces.
Pen No. 1	252.25	83.25	36.0	291.0
Pen No. 3	172.75	55.50	24.0	220.75
	Corn meal.			
Pen No. 2	252.25	83.25	36.0	291.0
Pen No. 4	172.92	55.50	24.0	217.58

The mixture of linseed meal and bran, and the corn meal, was, except for the first few days, fed dry, as it was then eaten more readily. Fresh water was kept in each pen.

After May 1 each pen was given, daily, freshly-cut green grass. This was not weighed or analyzed, but the pens fared equally.

Analyses were made of the materials, fed with the following results:

	Per cent water.	Per cent ash.	Per cent fat.	Per cent glucose.	Per cent sucrose.	Per cent albuminoids.	Per cent fiber.	Per cent starch.
Linseed meal and bran	12.96	4.87	3 42	2.37	3.90	26.87	7.62	37.99
Wheat	13.41	1.92	1.52	1.56	2.22	10.87	2.83	65.67
Corn meal	17.09	1.21	4.01	1.16	2.26	9.69	2.16	62.42
Apples	84.00	.44	*.61	6.36	6.04	.34	1.05	†1.16
Boiled potatoes	78.11	1.08	.06	.21	.19	2.39	.58	17.38

Calculated from these analyses, the total weight of the different constituents fed to each fowl for the entire period was:

	Pen No. 1.	Pen No. 2.	Pen No. 3.	Pen No. 4.
	Ounces.	Ounces.	Ounces.	Ounces.
Albuminoids	100.55	57.21	71.18	41.17
Ash	18.63	9.40	13.15	6.77
Fat	13.58	15.07	9.62	10.59
Glucose	15.89	12.84	11.11	8.98
Sucrose	21.40	17.26	15.04	12.14
Fiber	28.54	14.77	20.13	10.62
Starch	294.16	355.78	215.41	255.63
Total weight water-free food	492.75	482.33	355.64	345.90
N. free extract	331.45	385.88	241.56	276.75
Albuminoids	100.55	57.21	71.18	41.17
Ash	18.63	9.40	13.15	6.77
Carbhydrates	373,57	415.72	271.31	297.96
Proportion of albuminoids to carbhydrates.	1: 3.7	1: 7.27	1: 3.8	1: 7.24
Proportion of ash to total dry food	1:26.4	1:51.3	1:27.0	1:51.1

* Ether extract.

† Starch, acids, etc.

No account was taken of the digestibility of the foods. No factors were available except in regard to mammals; and there appears no reason for assuming that the digestibility of food by birds is the same.

The feed in Nos. 1 and 3 was always the more readily eaten, and the fowls always appeared lively and healthy. In Pen 2 one Wyandotte was sick in March, and one Brahma died June 1. In Pen 4 one Leghorn was sick in March, and one died in April. All comparisons between the pens are made on the average of one fowl. The two Wyandottes in Pen 2 were allowed to sit for two months from May 18. The Leghorns in Pens 3 and 4 all wanted to sit for some time, though very indifferently. During the last month or more, most of the fowls were moulting, and very few eggs were obtained.

Although a small product of eggs would naturally be expected from fowls fed continually on one food, the great difference in yield is worthy of attention.

The average per fowl for the period was:

PEN.	Proportion of albuminoids to carbhydrates in feed.	Number eggs.	Total wt., grammes.	Average weight one egg, grammes.
No. 1	1:3.7	12.50	688.63	55.01
No. 2	1:7.27	33.75	1878.73	55.67
No. 3	1:3.8	12.25	657.90	53.70
No. 4	1:7.24	41.42	2290.57	52.89

It would appear that the ratio of constituents in the feed of Nos. 2 and 4 was much nearer the proper one for egg production. Whether the corn meal was favorable, or whether the linseed meal was unfavorable to the production of eggs, it is at present impossible to say. Although the fowls in Nos. 1 and 3 were throughout in better health, yet those in 2 and 4 kept their weight better.

During the first four weeks:

No. 1 lost in weight, .3 per cent.
No. 3 lost in weight, .9 per cent.

No. 2 gained in weight, 1.8 per cent.
No. 4 gained in weight, 3.7 per cent.

During the last six weeks:

No. 1 lost in weight, 3.7 per cent.
No. 3 lost in weight, 10.7 per cent.

No. 2 gained in weight, .7 per cent.
No. 4 lost in weight, 6.1 per cent.

The amount of manure collected from the roost-platform for the entire period was from:

Pens Nos. 1 and 2, average per fowl, 5.24 pounds.

Pens Nos. 3 and 4, average per fowl, 2.46 pounds.

Analyses were made of the eggs from the different pens. Several eggs were used for each analysis. The shells (and lining membrane) were removed, and an intimate mixture of the whole contents made, with the exception of the membrane which surrounds the yolk and the two ligaments connecting it with the membrane forming the cells of the white. The weight of this portion discarded was (on average in eight eggs) only .03 per cent of the entire weight of egg. The analysis represented the composition of the entire edible portion of the egg.

Ash was determined at a high temperature with very constant results. This ash consisted mostly of phosphates. No facilities were available for determining the volatile ash, and determinations made of the total ash were unreliable (duplicates did not agree).

No eggs were analyzed until the feeding had been continued for three months. Unfortunately, no eggs were then obtained from No. 1. The results are as follows:

Pen No. 2 — (Twenty-nine eggs analyzed).

(Ratio in feed of albuminoids to carbhydrates, 1:7.27; ratio of ash to total dry food, 1:51.3.

	Water.	Fat.	Albuminoids.	Ash,	Total solids.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Highest found	73.28	12.37	13.54	.97	27.97
Lowest found	72.03	10.03	13.17	.74	26.78
Average all analyses	72.83	11.06	13.36	.87	27.17

Pen No. 3 — (Eleven eggs analyzed).

(Ratio in feed of albuminoids to carbhydrates, 1:3.81; ratio of ash to total dry food, 1:27.)

	Water.	Fat.	Albuminoids.	Ash.	Total solids.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Highest found	75.31	9.49	12.91	1.58	24.87
Lowest found	75.13	9.09	12.60	1.35	24.69
Average all analyses	75.22	9.28	12.78	1.45	24.79

Pen No. 4 — (Twenty-two eggs analyzed).

(Ratio in feed of albuminoids to carbhydrates, 1:7.24; ratio of ash to total dry food, 1:51.1.)

	Water.	Fat.	Albuminoids.	Ash.	Total solids.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Highest found	74.65	10.20	12.91	.81	26.13
Lowest found	73.87	9.71	12.60	.65	25.35
Average all analyses	74.27	9.94	12.79	.74	25.73

The specific gravity of fresh eggs from the different pens was:

Pen No. 1, average of forty eggs, 1.088.

Pen No. 2, average of twenty-four eggs, 1.086.

Pen No. 3, average of eleven eggs, 1.095.

Pen No. 4, average of thirty-seven eggs, 1.091.

There was no appreciable difference in the specific gravity of eggs from pens of the same breeds differently fed. There was a greater difference in regard to breed, the brown shell eggs averaging 1.087 specific gravity and the white shell eggs averaging 1.092.

There was a slight difference in the chemical composition of eggs from different pens, as can be seen from the table. The most noticeable difference was in the ash. Eggs from No. 3 contained twice as much as those from No. 4 (the same breeds fed differently).

The chief difference between eggs from No. 2 and No. 4 (different breeds, fed the same) was in the per cent of water, those from No. 2 having less, making the per cent of other constituents somewhat higher. Other results in accord with this observation will be given later.

The per cent of shell in fresh egg was:

Pen No. 1, average of 40 eggs, 9.98 per cent shell.

Pen No. 2, average of 43 eggs, 9.95 per cent shell.

Pen No. 3, average of 21 eggs, 10.78 per cent shell.

Pen No. 4, average of 50 eggs, 10.86 per cent shell.

There was some difference in per cent of shell in regard to breed, the brown shell eggs averaging 9.96 per cent and the white shell averaging 10.82 per cent. The different feed had no effect on amount of shell, as the average for 1 and 3 was 10.38 per cent and for 2 and 4, 10.40 per cent.

It would appear from this result that the source from which the fowls obtained material for the egg shell was independent of that which furnished the ash constituents of the egg itself. The following table indicates this:

	Ratio of ash in feed to total water-free food.	Average per cent of non-volatile ash in egg.	Average per cent of shell to fresh egg.
Pen No. 3	1:27.0	1.45	10.78
Pen No. 4	1:51.1	.74	10.86

The amount of ash in the feed of No. 4 and the per cent of ash in the eggs were less than for No. 3. Yet, although the number of eggs was more than three times as great as from No. 3, the per cent of shell was practically the same (slightly higher). The carbonate of lime in the shells of eggs from Pen 4 (ninety per cent $CaCO_3$ in the shell) was 206.1 grammes average per fowl. The amount of lime, calculated to carbonate of lime, in the ash of the feed was, during the same time, only 11.3 grammes per fowl.

The per cent of the egg, free from shell, represented by the white and that represented by the yolk was determined in 154 eggs. There were continual slight, but no great, differences. Most of the results differed but little from the average. There was no variation in the proportion which seemed due to the influence of food or of breed.

The following results were obtained:

		Per cent as white.	Per cent as yolk.
Average forty eggs, Pen No. 1		63.95	36.05
Average forty-three eggs, Pen No. 2		65.21	34.79
Average twenty-one eggs, Pen No. 3		65.33	34.67
Average fifty eggs, Pen No. 4		62.38	37.62
Common average		64.22	35.78
In 154 eggs	Highest found	68.76	40.63
	Lowest found	59.37	31.24

Determinations of the loss of weight (moisture) in eggs exposed to the air gave the following results:

	Fresh weight.	Per cent loss in 10 days.	Per cent loss in 20 days.	Per cent loss in 30 days.
Average of 169 eggs	54.4	1.60	3.16	5.00
Average of 45 eggs, Pen 1	54.9	1.64	3.28	5.47
Average of 49 eggs, Pen 2	54.4	1.84	3.68	5.51
Average of 23 eggs, Pen 3	55.7	1.44	2.51	4.13
Average of 52 eggs, Pen 4	53.6	1.49	3.17	4.85
Average of Pens 1 and 2	54.7	1.74	3.48	5.49
Average of Pens 3 and 4	54.7	1.47	2.84	4.49

The loss was more rapid with eggs having the lighter shell. The loss in 1 and 2 was greater than in 3 and 4, and the average per cent of shell for eggs from 1 and 2 was 9.96 per cent and for those from 3 and 4 was 10.82 per cent. Eggs with cracked shells dried much more rapidly, but none with imperfect shells are included in these averages. The temperature of the room in which the eggs were kept was taken three times a day. The slight differences accompanying the fluctuations of temperature are of no consequence. The rate of loss increased somewhat with the temperature. The average temperature for the period over which the observations extended (April 15 to July 1) was 63.8° Fahrenheit. No eggs with perfect shells showed any indications of putrefaction at the end of thirty days.

About 500 determinations of specific gravity were made. About 130 eggs were used for this purpose. There was considerable variation in the individual eggs. The specific gravity of all the eggs, however, diminished regularly in proportion to the length of time they were kept. The following results were obtained:

	SPECIFIC GRAVITY.			
	Fresh eggs.	After 10 days.	After 20 days.	After 30 days.
Average of 40 eggs, Pen 1	1.088	1.067	1.047	1.027
Average of 24 eggs, Pen 2	1.086	1.068	1.045	1.024
Average of 11 eggs, Pen 3	1.095	1.078	1.062	1.047
Average of 37 eggs, Pen 4	1.091	1.076	1.057	1.042
Average of 112 eggs	1.090	1.072	1.053	1.035
Pen No. 1, highest	1.097	1.082	1.064	1.045
Pen No. 1, lowest	1.073	1.049	1.016	*
Pen No. 2, highest	1.095	1.082	1.071	1.047
Pen No. 2, lowest	1.072	1.050	1.021	1.000
Pen No. 3, highest	1.103	1.090	1.073	1.055
Pen No. 3, lowest	1.082	1.065	1.053	1.034
Pen No. 4, highest	1.104	1.095	1.075	1.062
Pen No. 4, lowest	1.075	1.054	1.030	1.002

The higher specific gravity of the white-shell eggs is probably due largely to the heavier shell. For, although there is a higher per cent of fat in the brown-shell eggs, the per cent of other constituents is higher and the water is less.

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* Less than 1.000

Although the per cent of shell was generally near to the averages previously given, there were some wider variations. The following were found among 154 determinations (none of the eggs were soft shell):

	Pen No. 1 (in forty eggs).	Pen No. 2 (in forty-three eggs).	Pen No. 3 (in twenty-one eggs).	Pen No. 4 (in fifty eggs).
Highest	11.52	14.00	13.38	15.09
Lowest	7.32	5.96	7.90	5.03

There were fewer of the extreme variations in Pens 1 and 3, but the number of eggs laid was much less.

It has sometimes been proposed to test the freshness of eggs by the fact of their sinking or floating in solutions of a certain specific gravity. Even if the density of fresh eggs were a constant quantity, the solutions for determining it would require a more accurate method of standardizing than some that have been recommended. Specific gravity could be a good negative indication, but not an absolute one. The freshness of any egg which would float in a solution of 1.075 specific gravity, would be very questionable, but some eggs two weeks old would sink in the same solution.

Analyses were made of white and of brown-shell eggs, obtained from a mixed pen of fowls, fed on a varying ration (grain and green foods). The fowls which produced the brown-shell eggs were mostly of Plymouth Rock cross, a few of light Brahma cross. Those laying white-shell eggs were of brown Leghorn cross, a few of white Leghorn cross.

These fowls were in the same pen and had the same food and treatment. The results showed practically the same relation previously noticed in eggs from different breeds which were fed alike.

The analyses were as follows:

Brown Shell Eggs—(Twenty-one eggs).

	Water.	Fat.	Albuminoids.	Ash.	Total solids.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Highest found	73.94	11.20	14.05	.95	27.28
Lowest found	72.72	10.47	13.61	.92	26.06
Average all analyses	73.37	10.83	13.77	.93	26.63

White Shell Eggs — (Fourteen eggs).

	Water.	Fat.	Albuminoids.	Ash.	Total solids.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Highest found	74.86	10.57	13.16	.92	25.28
Lowest found	74.72	9.66	13.10	.85	25.14
Average all analyses	74.79	10.02	13.14	.89	25.21

The following table gives the results of all the analyses made:

Analyses of Eggs.

	Water.	Fat.	Albuminoids.	Ash (non-volatile).	Total solids.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
	73.87	10.14	12.60	.77	26.13
	73.89	10.20	12.85	.75	26.11
	74.41	9.71	12.79	.79	25.59
	74.65	9.80	....	.81	25.35
	74.41	9.90	12.85	.65	25.59
	74.38	9.86	12.91	.65	25.62
	75.25	9.15	12.85	1.35	24.75
	75.31	9.09	12.91	1.43	24.69
	75.13	9.39	12.60	1.58	24.87
	75.17	9.49	12.66	1.43	24.83
	73.11	10.44	....	.80	26.89
	73.22	10.67	13.54	.77	26.78
	73.28	10.86	....	.74	26.78
	73.15	10.50	13.17	.85	26.85
	72.88	10 03	Lost.	.95	27.12
	72.84	11.39	Lost.	.95	27.16
	72.03	12.37	13.23	.94	27.97
	72.07	12.21	13.48	.97	27.93
	73.94	10.56	14.05	.92	26.06
	73.92	10.47	13.74	.92	26.08
	73.44	Lost.	13.86	.95	26.56
	73.41	Lost.	13.61	.93	26.59
	72.72	11.10	Lost.	.94	27.28
	72.72	11.20	13.61	....	27.28
	74.83	(?) 9.66	13.16	.85	25.17
	74.86	9.84	13.16	.89	25.14
	74.74	10.57	13.16	.92	25.26
	74.72	Lost.	13.10	....	25.28
Average of ninety-seven eggs.	73.87	10.34	13.18	.94	26.13

The few results we have thus far been able to obtain, indicate that breed influences slightly the per cent of water of the egg, and feed affects the chemical composition.

Extended examination shows the composition of the egg to be very complex. But investigation and discussion of the detailed differences of composition seem at present to be only of scientific value.

Analyses of the ash of the white, and of the ash of the yolk, made some years ago by Poleck, show that the ash of yolk contained mostly phosphoric acid, and lime, less potash, soda, magnesia, iron and silica. The ash of the white consisted largely of soluble salts, potash and soda (in larger part as chlorides), phosphoric acid, carbonic acid, lime, silica, magnesia, iron and sulphur.

The shells consist largely of carbonate of lime, with some phosphates and organic matter.

Analyses by Vauquelin and by Proust gave:

	V. Per cent.	P. Per cent.
Carbonate of calcium	89.6	91.0
Phosphate of calcium and less phosphate of magnesia	5.7	7.0
Animal matter containing sulphur	4.7	2.0

Analyses of egg shells by W. Wicke gave:

	Goose.	Hen.	Duck.
Calcium carbonate	95.26	93.70	94.42
Magnesium carbonate	.72	1.39	.50
Phosphates	.47	.76	.84
Organic substances	3.55	4.15	4.24

Roussin found when different mineral salts were added to the food of hens, that the calcium carbonate of the shells was more or less replaced by isomorphous salts, "carbonates of barium, strontium and even of lead, but especially by magnesium carbonate." "The addition of calcium arsenate was fatal to some of the hens, nevertheless arsenic was found in the egg shells." "When alkaline bromides and iodides were added to the food, alkaline chlorides of the white and yolk of the egg were partly replaced by these salts. The increase in the proportion of bromide or iodide was, however, attended with a diminution of the calcareous envelope, which untimately disappeared altogether, leaving the egg surrounded only by a membrane." It is not at all probable that the small quantities of bromide which are given to hens in medicine have any injurious effect on the egg.

Eggs (of different breeds) which we have had for hatching averaged a greater weight than those laid by the pullets, in the experiments reported. The average weight per egg was 2.07 ounces. The Brahma eggs were the largest, averaging 2.32 ounces. The average of Light Brahma, Plymouth Rock and Buff Cochin eggs was 2.14 ounces; White Leghorn eggs averaged 2.09 ounces. Other white-shell eggs averaged considerably less.

Analysis was made of a sample of "Excelsior meal" (a poultry food) made of proportions recommended by Felch. The following result shows it to be a valuable food:

	Per cent.
Water	9.64
Ash	3.10
Fat	3.61
Glucose	1.16
Sucrose	1.99
Albuminoids	13.05
Fiber	6.51
Starch	60.94

It is intended to make some experiments in feeding pullets, cockrels and capons, for the purpose of securing accurate data in regard to the cost of feeding and the value of products obtained, and the best rations for egg and meat production. The experiments will be undertaken as soon as buildings and pens are available.

While we have not sufficient data for any absolute conclusions, the few results that we have give the following indications:

That the proportion of food consumed by hens of smaller breeds to that consumed by those of the larger is very much greater while both are laying than while they are not.

That different food influences not only the number of eggs produced, but also their chemical composition.

That breed, as indicated in the color of the eggshell, influences the per cent of water in the egg.

That the hen is able to obtain from inorganic material a supply of lime for the formation of the eggshell.

That eggs gradually lose weight when exposed to the air.

That the specific gravity of fresh eggs is not constant. That the limits of variations in eggs, from hens not used for breeding, are about 1.072 and 1.104. That the specific gravity diminishes in proportion to the time the egg is kept exposed to the air.

SORGHUM.

One hundred and sixty-two samples of sorghum seed and three samples of millet seed were planted in separate rows, numbered from 1 to 165 consecutively. Twenty-seven samples of sorghum seed, five of which came from China and twenty-two from India, were from varieties new to the United States.

Two samples of millet seed came from China and one from Sierra Leone. There were six varieties of sorghum which were introduced into this country from China five years ago.

There were several varieties which came from Natal five years ago. The rest were nearly all varieties introduced into the United States by Wray in 1857. One variety (No. 157) was received from the Department of Agriculture.

The soil where the sorghums were grown was a rich clay loam. No fertilizer was used. The soil favored a large growth, but slow maturity. The season was cool; the sorghum (and corn) ripening about two weeks later than usual. The observations taken on the crop are condensed in the the following table. The date of the ripening of the seed is very frequently questionable, as the sparrows destroyed the seed before it was mature. Neither could any observations be made in regard to yield and quality of seed.

The seed was all planted on May 24. The plants were killed by frost October 11. The frosts which occurred before this date were only severe enough to kill the top leaves of the immature canes.

Those samples, the names of which are inclosed by bracket, if not absolutely identical, are so near alike that for all practical purposes they may be considered the same variety.

Variety.	Row number.	NAMES, ETC.	MATURITY.		Stalks from root.	Suckers from top.	Average height.	Average diameter.	Average weight.
			Panicle first appearing.	Seed ripe.			Ft.	In.	Ozs.
Lall Jowar	1	Red Sorghum (Calcutta)	Aug. 20		Several	None	4.9	.8	7.3
(Var. Bicolor) Lall Jowar	2	Red Sorghum (Calcutta)	Aug. 10	Oct. 5	Several	Sometimes	5.6	.8	10.5
Doodhia Jowar	4	White Sorghum (Calcutta)	Aug. 25		Many	None	5.6	.7	6.3
Maila Jowar	5	(Calcutta)	Aug. 25		Several	None	4.3	.6	5.8
(Var. Bicolor) Bl'ck Sorghum	6	(Calcutta)	Aug. 6	Sept. 24	Several	Sometimes	6.4	.9	†11.0
	7	Sorghum No. 1 (Foochau)	Aug. 5	Sept. 25	Few	Often	5.5	.7	†6.5
	8	Chinese Sorghum (Japan)	Aug. 25		Several	None	7.6	1.0	†17.8
	10	Shanghai Sorghum	Aug. 15		Several	None	7.6	.8	†11.5
	11	Pootung Sorghum	Aug. 14		Several	None	7.3	.8	†13.5
	12	Tsung Ming Sorghum	Aug. 14		Several	None	7.3	.9	†12.1
Boomvana	9	Early Amber (Japan)	Aug. 6	Sept. 25	Several	Generally	6.9	.8	12.2
	103	Early Amber (United States)	Aug. 7	Sept. 25	Several	Generally	7.7	.7	13.6
	112	Early Golden	Aug. 13	(?)	Several		7.6	.6	10.9
	125	Early Golden (Swain),	Aug. 14	Oct. 8	Several		8.0	.8	17.0
	146	Early Golden	Aug. 10	Sept. 26	Many		7.6	.9	18.1
	160	Early Amber (Stirling)	Sept. 20		Several		9.4	1.2	*22.8
	163	Early Amber (Hughes)	Aug. 11	Oct. 3	Several		7.9	.7	†11.9
	13	Chowari Jowari (India)			Many		9.2	1.2	*22.8
	14	Bilemudhinandial Jowaree			Several		8.2	1.2	*19.9
	15	Bilenandial Jowaree			Very many		9.2	1.1	*18.5
	16	Aragabwin Jowaree	Oct. 4		Many		7.6	1.0	*18.6
	17	Sali Jowaree (Param)			Very many		7.4	1.3	*17.7
	18	Karegoni Jowaree	Oct. 6		Many		8.0	1.1	*23.5
	20	Giddtambadee Jowaree	Aug. 31		Several		6.4	.8	16.2
	21	Bilehandidimisadi Jowaree			Many		8.5	1.1	*20.4
	22	Bilichigan Jowaree	Sept. 20		Many		8.4	1.1	*15.2
	23	Kapekanamuchakan Jowaree			Many		8.5	1.1	*19.3
	24	Jalakanandyal Jowaree			Several		9.0	1.0	*18.7
	25	Karigoni Niddagen Jowaree	Sept. 16		Several		8.4	1.0	17.2
	26	Mudhynandyal Jowaree	Oct. 4		Few		9.5	.8	13 0
	27	Handimodadi Jowaree	Sept. 24		Few		8.1	1.0	*21.9
	28	Autar Sali Jowaree			Several		8.3	1.1	*20.6
Er Chin Hung Liang	32	Second Autumn Red Millet	Aug. 4	Sept. 25	Few	Sometimes	6.3	.8	7.4
	39	Second Autumn Red Millet	Aug. 4	Sept. 26	Generally but one	Some	6.6	.6	6.3
	40	Second Autumn Red Millet	Aug. 4	Sept. 25	Generally but one	Some	6.6	.5	6.9
	49	Second Autumn Red Millet	Aug. 4	Sept. 25	Seldom more than one	None	7.1	.8	10.6
	51	Second Autumn Red Millet	Aug. 6	Sept. 25	Several		7.8	.7	‡12.0

† Uneven.

‡ Very uneven.

Variety.	Row number.	NAMES, ETC.	MATURITY.		Stalks from root.	Suckers from top.	Average height.	Average diameter.	Average weight.
			Panicle first appearing.	Seed ripe.			Ft.	In	Ozs.
	33	Odd—from Jyangentombi	Sept. 5		Few		6.3	.9	12.0
	34	Odd—from Hlogonde	Sept. 9		Several		6.9	.9	11.1
	93	Odd—from Uboyana	Sept. 24		Few		6.5	1.0	17.9
	35	White Imphee	Aug. 8	Oct. 10	Few		7.5	.7	§12.3
	86	Gray Top	Aug. 27		Several		6.5	1.0	†14.7
Neeazana	37	New Variety—Haswell	Aug. 7	Sept. 29	Few		6.0	.6	9.5
	46	Neeazana	Aug. 15		Several		6.7	.7	10.4
	55	Neeazana	Aug. 13	Oct. 10	Few		6.4	.7	11.7
Ma Wei Nien Liang	38	Horse-Tail Glutinous Millet	Aug. 6	Sept. 27	Seldom more than one	None	6.6	.7	9.5
	48	Horse-Tail Glutinous Millet	Aug. 6	Sept. 26	One	None	7.4	.7	13.0
	61	Horse-Tail Glutinous Millet	Aug. 6	Sept. 26	Generally but one	None	7.6	.8	7.5
	41	Odd—from Er Chin Hung Liang	Sept. 4	(?)			9.1	.8	12.2
Jyangentombi	42	Jyangentombi (Natal)	Aug. 7	Sept. 26	Few		6.5	.9	14.3
	43	Odd—from Jyangentombi	Oct. 5		Few		8.2	1.1	22.0
	52	Odd—from Jyangentombi			Few		8.3	1.0	*21.4
Hlogonde	44	Hlogonde (Natal)	Sept. 14		Several		8.4	1.0	*15.9
Koombana	45	Unhlokonde	Aug. 10	Oct. 8	Many		7.7	.7	13.0
	47	Chineese Imphee	Aug. 7	Oct. 7	Few		7.7	.8	15.0
	94	Iowa Red Top	Aug. 7	Oct. 5	Few		7.1	.6	14.6
San Sui Pai Liang	50	Separated-Head-Stalks White M't.	Aug. 4	(?)	Seldom more than one	None	7.5	.6	6.3
	59	Separated-Head-Stalks White M't.	Aug. 7	Sept. 26	Generally but one	None	8.5	.8	13.8
	60	Separated-Head-Stalks White M't.	Aug. 7	Oct. 10	Several	None	8.9	.7	9.6
	69	Separated-Head-Stalks White M't.	Aug. 20		Several		10.0	.7	9.8
Ufatane	53	Uftane (Natal)	Oct. 1		Several		7.7	.9	*10.9
	54	Odd—from Number 35	Aug. 7	Sept. 25	Few		9.2	.9	†13.8
	56	New Variety (Bradford)	Aug. 20		Few		8.4	.8	16.1
	66	New Variety (Bradford)	Aug. 26		Few		8.5	.8	18.3
	77	Odd—from New Variety (Bradf'd).	Aug. 26		Few		7.7	.7	†15.3
Black Sorgho	57	Black Sorgho (India)	Aug. 11	Oct. 10	Generally but one	None	6.6	.7	12.6
	85	Black Sorgho (India)	Aug. 7	Sept. 28	Several		7.4	.7	12.8
	95	Black Sorgho (India)	Aug. 13		Few		7.1	.7	†12.2
	115	Black Sorgho (India)	Aug. 11		Several		9.0	.9	‡19.5
Ta Min Hung Liang	58	Large-People's Red Millet	Aug. 5	Sept. 26	Generally but one	None	8.0	.7	10.5
	71	Large-People's Red Millet	Aug. 4	Sept. 25	Seldom more than one	None	7.5	.6	8.3
	81	Large-People's Red Millet	Aug. 10	(?)	Several		7.3	.7	6.1
	90	Large-People's Red Millet	Aug. 4	Sept. 24	Seldom more than one	None	6.2	.6	7.0
Ta Min Hung Liang......(?)	99	Odd—from Ta Min Hung Liang	Aug. 7	Oct. 5	Few		9.0	.7	11.3
Ta Min Hung Liang......(?)	100	Odd—from Ta Min Hung Liang	Aug. 7	Oct. 6	Few		9.0	.7	9.8

Ukubane	62	Ukubane (Natal)	Aug. 18	....	One	None	5.1	1.2	12.6
	105	Ukubane (Natal)	Aug. 24	....	Seldom more than one	....	5.5	1.0	14.6
	106	Ukubane (Natal)	Aug. 30	....	Seldom more than one	....	5.5	1.0	14.2
	72	Ukubane (?) (Natal)	Aug. 12	Sept. 28	Several	....	8.2	.7	§13.6
	82	Ukubane (?) (Natal)	Aug. 12	Oct. 10	Several	....	7.6	.9	‡14.0
Ibohla	63	Ibohla (Natal)	Sept. 18	....	Several	....	10.4	.9	20.3
White African	64	White African	Aug. 11	....	Many	....	9.2	.9	15.4
	65	Standard (Harrall)	Sept. 12	....	Several	....	9.9	.9	17.5
	76	Link's Hybrid	Sept. 11	....	Many	....	8.8	.9	18.4
	135	Standard	Sept. 16	....	Many	....	9.7	1.0	26.9
	154	Hybrid (E. Link)	Sept. 17	....	Several	....	8.0	.9	21.2
	86	Standard No. 2 (Harrall)	Sept. 26	....	Several	....	9.2	.8	20.7
	67	Odd—from Red Sorgho	Aug. 20	....	Several	....	9.5	.9	16.2
Red Sorgho	78	Red Sorgho (India)	Aug. 7	Oct. 6	Few	Sometimes	8.3	.8	§14.7
	114	Red Sorgho (India)	Aug. 14	....	Few	....	6.8	.7	12.3
Undendebule	68	Unendebule (Natal)	Sept. 10	....	Many	....	9.5	.8	17.9
	91	Unendebule (Natal)	Sept. 6	....	Several	....	9.2	.9	16.0
San Sui Hoong Liang (?)	70?	Odd—from San Sui Hoong Liang	Aug. 4	Sept. 25	Generally one	None	7.0	.6	7.0
	80	Separated Head-stalks Red Millet	Aug. 4	Sept. 25	Few	None	6.4	.5	6.1
	88	Odd—from San Sui Hoong Liang	Aug. 6	Sept. 26	Seldom more than one	None	7.1	.6	6.3
	97	Separated Head-stalks Red Millet	Aug. 4	Sept. 26	Generally one	....	7.0	.5	7.5
	108	Separated Head-stalks Red Millet	Aug. 4	Sept. 25	Generally one	....	6.9	.6	8.5
Dindemuka	73	Dindemuka (Natal)	Aug. 12	Oct. 10	Several	....	7.2	1.0	17.8
	87	Dindemuka (Natal)	Aug. 11	Oct. 7	Generally but one	....	7.1	.9	17.3
Umgatubanda	74	Umgatubanda (Natal)	Sept. 10	....	Several	....	8.0	1.1	19.4
	133	Umgatubanda (Natal)	Aug. 31	....	Several	....	7.0	1.0	15.1
Enyama	75	White Mammoth	Sept. 20	....	Several	....	8.9	1.0	21.5
	155	Enyama (?) (Link)	Sept. 20	....	Several	....	9.2	1.0	25.6
Uboyana	83	Uboyana (Natal)	....	....	Many	....	9.1	1.0	*17.9
	92	Uboyana (Natal)	....	....	Several	....	9.0	1.2	*22 7
	101	Uboyana (Natal	Sept. 23	....	Few	....	7.3	1.1	16.9
	102?	Odd—from Uboyana	Sept. 11	....	Few	....	8.5	1.0	‖18.5
	84	West India	Sept. 6	....	Several	....	8.0	.8	†15.1
	113	West India	Sept. 17	....	Several	....	9.8	.9	17.8
	120	Chinese (D. Smith)	Sept. 9	....	Several	....	8.4	.9	15.1
	126	Goose Neck (P. P. Ramsey)	Sept. 5	....	Several	....	7.5	.7	14.8
Hwang Mao Nien Liang	89	Yellow Cap Glutinous Millet	Aug. 15	....	Seldom more than one	....	7.4	.6	7.4
	104	Yellow Cap Glutinous Millet	Aug. 6	Oct. 5	Seldom more than one	....	7.6	.6	†8.9
	138?	Odd—from Hwang Mao Nien Liang	Aug. 6	Sept. 26	Many	....	7.9	.7	‡7.6
Ufatane	96	Ufatane (Natal)	Oct. 6	....	Several	....	7.0	1.0	*19.7
	107	Ufatane (Natal)	Sept. 27	....	Several	....	9.2	.8	17.8
	132	Odd—from Ufatane	Aug. 10	Sept. 29	Several	....	6.8	.7	10.8
Vimbischuapa	109	Honduras	Aug. 22	....	Several	....	10.0	.9	24.2
	110	Honey	Aug. 26	....	Several	....	10.0	1.0	22.7
	156	Honduras	Aug. 28	....	Many	....	10.0	1.0	22.8

§ Uneven mixed. † Uneven. ‡ Very uneven. ‖ Mixed.

Variety.	Row number.	NAMES, ETC.	MATURITY.		Stalks from root.	Suckers from top.	Average height.	Average diameter.	Average weight.
			Panicle first appearing.	Seed ripe.			Ft.	In.	Ozs.
Vimbischuapa (?)	157	Chinese Sugar Cane (D. of A.)	Sept. 11		Several		10.9	.9	15.5
	111	H. P. W.'s Seed	Aug. 10	Oct. 8	Several		8.6	.8	§17.7
	118	Kansas Orange Cane	Aug. 27		Few		8.6	1.0	19.0
	119	Liberian (Leaming)	Aug. 7	Oct. 1	Several		7.8	.8	¶15.9
	124	Sugar Cane (J. W. Borger)	Aug. 15		Several		7.9	.8	16.8
Ubehlana (?)	116	Odd—from Ubehlana	Sept. 27		Few		(?)8.3	(?)1.1	(?)10.8
	136	Odd—from Ubehlana			Many		8.2	1.2	*23.3
	117	Variety (Stump)	Aug. 27		Few		7.8	.9	‖18.5
	123	Early Orange (Hedges)	Sept. 4		Few		7.8	.8	17.5
	162	Late Orange (H. A. Hughes)	Aug. 23		Few		7.6	.8	17.7
	121	African (W. E. Parks)	Aug. 14	Oct. 5	Several		8.1	.7	‡13.1
	122	Regular Sorgho (B. & Co.)	Sept. 5		Several		9.8	.7	‡13.2
	127	Liberian (Yellow Springs)			Many		8.3	1.1	17.4
	144	" No. 52-1884"			Many		7.1	1.0	*12.9
	158	Sorghum (Carpenter)	Sept. 20		Few		9.1	1.1	27.1
	159	Orange (Stirling Syrup Works)	Aug. 6	Sept. 26	Few		8.0	.7	†13.4
	161	Variety (Stirling Syrup Works)	Aug. 6	(?)	Several		8.4	.6	†8.7
	164	Early Orange (H. A. Hughes)	Sept. 11		Several		8.9	1.1	18.9
	165		Aug. 31		Several		8.5	.9	15.4

§ Uneven, mixed. ¶ Very uneven, mixed. ‖ Mixed. ‡ Very uneven. † Uneven.

Only one of the millets appeared of any value for this climate. This (row 29) was received from Foochau, China. The stalks were about three and eight-tenths feet high and four-tenths inch in diameter, and but one from each root. The stalks and leaves were rough, hard and dry. The drooping seed head, about twelve inches long and one and one-fourth inches in diameter, gave a good crop of small, yellow seed, the kernels being about one-sixteenth inch in diameter, ripe about October 1. This variety will be tried in the field another season. The other millet from Foochau had very large bunches of small stalks from each root, but did not approach maturity.

The "Guinea corn" from Sierra Leone had very many leafy stalks from each root, which were about four and four-tenths feet high when killed by frost, and at that time showed no signs of maturity.

The following named varieties of sorghum will probably yield a crop as often as the common varieties of corn grown in this State. Those marked with a * are of value only for seed and fodder:

Lall Jowar (variety Bicolor)	2
Black Sorghum (variety Bicolor)	6
Sorghum No. 1 (Foochau) *	7
Chinese Sorghum (Tsung Ming)	8, 10, 11, 12
Boomvana	9, 103, 112, 125, 146, 160, 163
Er Chin Hung Liang *	32, 39, 40, 49, 51
White Imphee	35
Neeazana	37, 46, 55
Ma Wei Nien Liang *	38, 48, 61
Jyangentombi	42
Koombana	45, 47, 94
San Sui Pai Liang *	50, 59, 60, 69
Black Sorgho	57, 85, 95, 115
Ta Min Hung Liang *	58, 71, 81, 90, 99, 100
Ukubane *	62, 105, 106
Red Sorgho	78, 114
San Sui Hoong Liang *	70, 80, 88, 97, 108
Dindemuka	73, 87
Hwang Mao Nien Liang *	89, 104, 138
Orange (Sterling Syrup Works)	159

In favorable seasons, the following varieties would also mature:

Lall Jowar *	1
Doodhia Jowar *	4

White African	64
Orange (?), West India (?), etc.	84, 113, 120, 126
Vimbischuapa	109, 110, 156
Orange (?), (Siberian, etc.)	111, 118, 119, 124

All the other varieties, including many of the best sugar-producing canes, require a much longer growing season than usually occurs in this State.

Many of the varieties of sorghum mentioned yield a large crop of handsome seed, but a seed crop is very improbable in localities where English sparrows are found.

Small flocks of from fifty to 100 sparrows appear in the field as soon as the sorghum is in bloom. Many heads are destroyed before the seed is formed. A much greater amount of seed is scattered on the ground than is eaten by the birds. They do not eat the seed from the ground so long as any remains on the stalk.

With considerable trouble, a few seed-heads were saved this year, and these were badly mutilated. Although many sparrows were shot, efforts to keep them away were unsuccessful.

Some attempts at hybridizing were made by Mr. Beckwith, but the sparrows tore open the bags which covered the panicles and destroyed the seed.

Selection of seed was made from the earliest maturing, and best-proportioned canes of each variety. Seed from those canes which contained the highest per cent of sugar was saved for planting. The results of analyses of the juices from individual canes are given in the following table. Some of them were made when the cane was still green. Most of them were made when the seed had just become hard:

Variety.	Row number.	NAME, ETC.	Date.	Analysis number.	Per cent juice.	Specific gravity, juice.	Per cent solids not sugar.	Per cent glucose.	Per cent sucrose.	Maturity of seed.
Lall Jowar	1	"Red Sorghum" (Calcutta)	Oct. 10	2,560	39.65	1.054	4.43	.47	8.23	In milk.
	1	"Red Sorghum" (Calcutta)	Oct. 13	2,569	37.03	1.053	6.55	.47	6.29	In milk.
Lall Jowar (Bicolor)	2	"Red Sorghum" (Bicolor), (Calcutta)	Oct. 9	2,555	54.43	1.059	4.86	1.20	8.71	Ripe.
	2	"Red Sorghum" (Bicolor)	Oct. 13	2,570	58.88	1.050	3.26	1.12	8.22	Ripe.
Doodhia Jowar	4	White Sorghum (Calcutta)	Oct. 11	2,561	23.21	1.081	5.17	.79	13.81	In milk.
	4	White Sorghum (Calcutta)	Oct. 13	2,572	43.59	1.066	5.42	.68	10.16	In milk.
Maila Jowar	5	Maila Jowar (Calcutta)	Oct. 10	2,559	28.18	1.066	3.78	1.11	11.37	Ripe.
	5	Maila Jowar (Calcutta)	Oct. 13	2,571	40.00	1.066	5.42	.68	10.16	Ripe.
Black Sorghum (Bicolor)	6	Black Sorghum (Bicolor), Calcutta	Oct. 9	2,553	50.00	1.049	1.75	3.88	6.56	Ripe.
	6	Black Sorghum (Bicolor), Calcutta	Oct. 10	2,558	58.70	1.061	4.81	1.71	8.84	Ripe.
	6	Black Sorghum, (Bicolor), (L.)	Sept. 26	2,511	57.14	1.072	4.73	1.82	11.28	
	7	Sorghum No. 1 (Foochau), (L.)	Sept. 25	2,508	48.12	1.056	6.14	.71	7.12	
	7	Sorghum No. 1 (Foochau)	Oct. 10	2,557	28.57	1.065	6.97	1.25	7.89	Ripe.
Boomvana	9	Early Amber (L.), Japan	Sept. 18	2,488	56.75	1.072	3.17	1.73	12.93	Ripe.
	9	Early Amber, Japan	Sept. 27	2,514	55.48	1.071	4.03	2.56	11.02	Ripe.
	9	Early Amber (L.), Japan	Oct. 3	2,535	60.71	1.087	7.55?	1.08	11.93?	
	9	Early Amber, Japan	Oct. 9	2,554	59.16	1.065	1.93	2.61	11.57	Ripe.
	9	Early Amber, Japan	Oct. 18	2,573	61.45	1.064	3.55	2.54	9.93	Ripe.
	103	Early Amber	Oct. 6	2,547	60.86	2.058	3.43	2.62	8.44	Ripe.
	112	Early Golden (L.)	Sept. 26	2,510	60.37	1.078	4.56	1.74	13.12	
Boomvana (?)		Amber (Landreth)	Sept. 18	2,486	59.46	1.066	1.51	2.58	12.17	
		Amber (Landreth)	Sept. 18	2,490	58.33	1.070	2.90	2.06	12.47	
		Amber (Landreth)	Sept. 19	2,494	54.16	1.073	3.46	1.61	12.81	
		Amber (Landreth)	Sept. 25	2,504	62.29	1.077	3.49	2.91	12.55	
	10	Shanghai Sorghum (L.)	Sept. 25	2,501	61.53	1.057	Lost.			
	11	Pootung Sorghum (L.)	Sept. 17	2,483	59.61	1.063	3.01	3.56	9.19	
	11	Pootung Sorghum (L.)	Oct. 3	2,536	68.39	1.069	3.64	2.43	11.09	
	11	Pootung Sorghum	Sept. 27	2,515	52.85	1.062	3.76	2.35	9.41	Ripe.
	12	Tsung Ming Sorghum (L.)	Sept. 24	2,497	68.75	1.064	3.56	3.53	8.93	
	14	Bilemudhinandial Jowaree	Oct. 12	2,565	40.00	1.058	6.62	1.58	6.29	Before bloom.
	20	Giddtambadee Jowaree	Oct. 9	2,556	55.05	1.049	4.59	1.80	5.80	In bloom.
	22	Bilichigan Jowaree	Oct. 11	2,562	45.34	1.051	6.21	1.12	5.23	Before bloom.
	25	Karigoni Niddagen Jowaree	Oct. 11	2,563	49.50	1.050	6.73	1.15	4.72	Before bloom.
	27	Handimodadi Jowaree	Oct, 11	2,564	46.36	1.047	5.70	1.24	4.92	Before bloom.
Er Chin Hung Liang	32	"Second Autumn Red Millet" (L.)	Sept. 19	2,492	43.47	1.060	6.31	1.63	7.18	
	32	"Second Autumn Red Millet"	Sept. 28	2,516	30.23	1.059	5.54	1.08	8.15	Ripe.
	39	"Second Autumn Red Millet" (L.)	Sept. 25	2,500	49.15	1.071	6.39	.76?	10.46?	
	39	"Second Autumn Red Millet"	Sept. 28	2,518	31.47	1.065	6.50	.92	8.69	Ripe.
	49	"Second Autumn Red Millet" (L.)	Sept. 26	2,512	45.59	1.074	6.04	1.45	10.79	
	51	"Second Autumn Red Millet"	Sept. 29	2,521	42.39	1.034	4.93	.91	2.83	Ripe.

Variety.	Row number.	NAME, ETC.	Date.	Analysis number.	Per cent juice.	Specific gravity, juice.	Per cent solid not sugar.	Per cent glucose.	Per cent surcose.	Maturity of seed.
	93	Odd—from Ubayana (L.)	Sept. 25	2,509	64.78	1.073	2.70	3.59	11.59	
	35	White Imphee	Oct. 12	2,566	50.00	1.058	3.39	2.29	8.81	Ripe.
Neeazana	37	New Variety (Haswell)	Oct. 12	2,567	67.85	1.046	2.85	2.17	6.56	Ripe.
	37	New Variety (Haswell)	Oct. 18	2,576	54.83	1.047	2.96	2.20	6.70	Ripe.
	55	Neeazana (L.)	Sept. 25	2,503	62.71	1.079	3.26	3.74	12.19	
Ma Wei Nien Liang	38	Horse-Tail Glutinous Millet	Sept. 28	2,517	34.22	1.054	4.63	1.05	7.45	Ripe, hard.
	48	Horse-Tail Glutinous Millet (L.)	Sept. 25	2,507	51.06	1.065	6.11	1.14	8.86	
	61	Horse-Tail Glutinous Millet (L.)	Oct. 2	2,532	44.73	1.073	5.05	.84	11.99	
Jyangentombi	42	Jyangentombi (Natal)	Sept. 28	2,519	52.45	1.033	4.74	.61	3.21	In milk.
	42	Jyangentombi (Natal)	Oct. 18	2,574	62.16	1.060	3.66	1.84	9.62	Ripe.
Koombana	45	Unhlokonde (L.)	Sept. 18	2,489	60.00	1.066	3.50	2.93	9.83	
	45	Unhlokonde (L.)	Oct. 3	2,537	54.05	1.070	5.67	1.03	10.73	
	45	Unhlokonde	Oct. 18	2,575	68.33	1.060	3.38	2.08	9.66	Ripe.
	47	Chinese Imphee (L.)	Sept. 25	2,506	88.18	1.077	5.17	1.21	12.57	
	47	Chinese Imphee	Sept. 29	2,520	50.79	1.061	4.53	2.65	8.18	Ripe.
	94	Iowa Red Top	Oct. 6	2,546	62.83	1.044	2.05	3.66	5.48	Soft.
San Sui Pai Liang	50	Separated Head-stalks White Millet (L.)	Oct. 2	2,533	46.40	1.070	5.17	.91	11.35	
	59	Separated Head-stalks White Millet (L.)	Sept. 17	2,485	62.22	1.062	3.74	1.17	10.61	
	59	Separated Head-stalks White Millet (L.)	Oct. 3	2,534	37.50	1.088	6.17	.92	14.31	
Ufatane (?)	53	Ufatane (Natal), (L.)	Sept. 25	2,505	66.33	1.064	4.23	2.83	8.96	
Black Sorgho	57	Black Sorgho (India), (L.)	Sept. 25	2,502	62.90	1.075	Lost.	Lost.	Lost.	
	57	Black Sorgho (India)	Sept. 29	2,522	41.41	1.048	5.38	1.30	5.42	Soft.
	85	Black Sorgho (India)	Oct. 1	2,526	38.26	1.048	5.43	1.11	5.56	Soft.
		Black Sorgho (L.)	Sept. 24	2,498	65.43	1.072	3.43	2.42	11.98	
Ta Min Hung Liang	58	Large People's Red Millet (L.)	Oct. 2	2,531	50.73	1.063	4.77	.80	10.19	
	58	Large People's Red Millet	Sept. 29	2,523	38.02	1.039	5.52	.75	3.72	Ripe, hard.
	90	Large People's Red Millet (L.)	Oct. 2	2,529	53.65	1.073	3.56	2.72	11.60	
	90	Large People's Red Millet	Oct. 6	2,545	34.14	1.032	5.31	1.10	1.75	Ripe (?)
	100?	Odd—from Ta Min Hung Liang (L.)	Oct. 2	2,528	48.87	1.072	6.73	.79	10.31	
Ukubane	106	Ukubane (Natal)	Oct. 20	2,579	60.00	1.034	4.28	1.60	2.79	In milk.
White African	64	White African	Oct. 20	2,577	58.02	1.062	4.31	3.07	8.14	In milk.
San Sui Hoong Liang	70	Odd—from San Sui Hoong Liang (L.)	Sept. 18	2,491	43.75	1.068	4.36	1.52	10.93	
	70	Odd—from San Sui Hoong Liang	Oct. 1	2,524	29.20	1.037	6.36	.81	2.56	Ripe, hard.
	80	Separated Head-stalks Red Millet	Oct. 1	2,525	34.05	1.046	7.57	.74	3.27	Ripe, hard.
	?88	Odd—from San Sui Hoong Liang (L.)	Sept. 18	2,487	48.48	1.061	4.89	1.53	8.94	
	?88	Odd—from San Sui Hoong Liang	Oct. 1	2,527	27.77	1.041	5.59	.90	3.94	Ripe.
	108	Separated Head-stalks Red Millet (L.)	Sept. 19	2,493	36.36	1.062	5.77	.68	9.07	
Dindemuka	73	Dindemuka (Natal)	Oct. 20	2,578	63.83	1.047	3.90	2.59	5.37	

Dindemuka	87	Dindemuka (Natal)	Oct. 12	2,568	48.61	1.044	5.01	1.28	4.90	Soft.
Hwang Mao Nien Liang	104	Yellow Cap Glutinous Millet (L.)	Sept. 26	2,513	49.22	1.061				
Vimbischuapa	110	Honey (L.)	Oct. 2	2,530	63.64	1.072	3.33	3.08	11.42	
	111	H. P. W.'s Seed (L.)	Sept. 17	2,481	49.02	1.053	2.73	2.31	8.27	
	111	H. P. W.'s Seed	Oct. 6	2,548	67.16	1.043	3.64	3.10	4.39	Soft.
	119	Liberian (Leaming)	Oct. 8	2,549	51.51	1.033	4.80	1.35	2.41	Soft.
	124	Sugar Cane (J. W. Borger), (L.)	Sept. 24	2,499	64.61	1.070	3.91	1.90	11.62	
	117	Variety (Stump), (L.)	Sept. 17	2,484	60.76	1.067	1.93	2.00	12.73	
	121	African (W. E. Parks)	Oct. 8	2,550	52.08	1.044	4.72	1.41	5.06	Ripe.
Jyenga	98	Jyenga (Natal), (L.)	Sept. 18	2,580	50.00	1.060	4.80	1.88	8.44	
		Dulcher's Hybrid (Landreth)	Sept. 17	2,482	57.00	1.061	2.51	3.04	9.81	
		(Denton), (Landreth)	Sept. 19	2,495	54.54	1.036	4.83	3.26	1.29	

The juices of three samples of corn stalks were analyzed with the following results:

	Date sample cut.	Per cent juice.	Specific gravity of juice.	Per cent solids not sugar.	Per cent glucose.	Per cent sucrose.
King Philip field corn .	Sept. 19	49.41	1.027	2.76	2.17	2.18
Evergreen corn.......	Oct. 8	58.18	1.034	2.50	2.32	3.85
Ruby sweet corn......	Oct. 8	58.35	1.059	4.00	2.14	8.65

Analyses were made of several samples of Early Amber sorghum, grown by the horticulturist on plats differently fertilized.

There were twenty-four plats which had been differently fertilized in 1887 and a crop of English Ray grass grown on them that year. In May, 1888, fertilizers were again applied to some of them and sorghum planted about the first of June. The rows were three and one-half feet apart and the stalks four or five inches apart. These plats had received no fertilizer for at least four years previously.

The kinds and amounts of fertilizing material applied was as follows:

PLAT NUMBER.	FERTILIZERS APPLIED, POUNDS PER ACRE, IN 1887.									FERTILIZERS APPLIED, POUNDS PER ACRE, IN 1888.			
	Sulphate of potash.	Muriate of potash.	Sulphate of ammonia.	Nitrate of soda.	Acid phosphate.	Ferrous sulphate.	Lime.	Gypsum.	Sodium chloride.	Sulphate of ammonia.	Nitrate of soda.	Sodium chloride.	Nitrate of potash.
I, XX	300	......	......	......	......	......	......	......	......	......	......	......	......
II, XVIII	......	......	150	......	......	......	......	......	......	150	......	......	......
III	......	......	......	......	350	......	......	......	......	......	......	......	......
IV	300	......	150	......	350	......	......	......	......	150	......	......	......
V	300	......	......	......	350	......	......	......	......	......	......	......	......
VI	300	......	150	......	......	......	......	......	......	150	......	......	......
VII	......	......	150	......	350	......	......	......	......	150	......	......	......
VIII	......	......	150	......	350	......	350	......	......	150	......	......	......
IX	300	......	150	......	......	......	350	......	......	150	......	......	......
X	300	......	150	......	350	......	350	......	......	150	......	......	......
XI	......	......	150	......	......	......	350	550	......	150	......	......	......
XII	300	......	150	......	350	......	......	550	......	150	......	......	......
XIII	......	......	......	......	......	......	350	......	......	......	......	......	......
XIV	......	......	......	......	......	......	......	550	......	......	......	......	......
XV, XXIV	......	......	......	......	......	......	......	......	......	......	......	......	......
XVI	......	......	......	......	......	......	......	......	100	......	......	100	......
XVII	......	......	......	180	......	......	......	......	......	......	180	......	......
XIX	......	150	......	......	......	......	......	......	......	......	......	......	......
XXI	......	......	......	......	......	50	......	......	......	......	......	......	......
XXII	*	......	......	......	......	......	......	......	......	......	......	......	......
XXIII	......	......	......	......	......	......	......	......	......	......	......	......	150

* Liberal application stable manure.

There was some difference in regard to size and ripening of cane from the different plats. The observations made by Mr. Goff were practically as follows :

Plats 1, 17, 2, tallest, ripest.

Plats 22, 7, 11, 23, next in maturity.

Plats 5, 6, not so tall, but maturity about like the preceding.

Plats 1, 3, 4, very slightly later in maturity than preceding.

Plats 18, 3, 15, 19, 8, 12, next in point of maturity.

Plats 16, 20, 24, next in point of maturity.

Plats 9, 10, 14, most backward.

The samples of cane for analysis were selected by Mr. Goff. The seeds of all were in the milky stage. Six stalks were taken from each plat ; the juice from them mixed and analyzed. Where two plats were fertilized alike the juice from both samples was mixed and one analysis made. As the first seven analyses showed no practical difference, no more were made. By mistake the sample from plat No. 23 was mixed with Nos. 15 and 24, which were from unfertilized plats. The analyses resulted as follows :

Date.	SAMPLE.	Per cent of juice.	Specific gravity of juice.	Per cent solids not sugar.	Per cent glucose.	Per cent sucrose.	Per cent cane sugar by polariscope.
Oct. 4 ...	Plats I and XX....................	61.72	1.068	3.43	3.65	9.73	9.98
Oct. 4 ...	Plats XIX.........................	61.97	1 066	3.46	3.84	8.96	9.10
Oct. 4....	Plats XV, XXIII and XXIV.......	62.63	1.068	2.88	4.01	9.92	9.82
Oct. 4....	Plats II and XVIII	62.68	1.067	3.27	3.61	9.78	9.91
Oct. 4....	Plats III.........................	60.62	1.067	3.18	4.09	9.39	9.47
Oct. 5....	Plats XVII........................	60.25	1.068	3.27	3.65	9.89	10.01
Oct. 5....	Plats IV..........................	61.46	1.066	3.13	3.96	9.17	9.17

CORN PLANTING.

Partial experiments made in corn planting, in regard to arrangement of hills, gave no very positive results.

Comparison was made between the rectangular and hexagonal (triangular) method and the method of planting in drills.

Four one-acre plats and eighteen tenth-acre plats were planted. On the large plats "King Philip" corn (an orange-colored flint variety) was planted, and on the smaller "Waushakum" (a yellow flint variety).

The two methods of planting in hills gave practically the same results. The yield from drills was slightly less. The average yield per acre for all was about sixty bushels of shelled corn and two and one-half tons of stalks.

The results give no definite indications, even in a negative way. The figures are therefore omitted. The data will be kept for future reference.

Analyses of Soil of the Farm.

Samples of soil were taken in April from every field of the farm. About fifty small vertical sections were taken and mixed for each sample.

The samples of top-soil were taken to depth of ten inches and the subsoil samples from the next six inches below.

Those fields, which were noticeably uneven, were divided in two or more parts, which were sampled separately.

It was intended to make analyses (partial at least) of all the samples, but so far it has been impossible without neglecting other work. Analyses will be made at the first opportunity.

REPORT OF THE HORTICULTURIST.*

INTRODUCTORY.

As usual, the experimental work carried on in this department the past season, has not been confined to strictly horticultural subjects. A synopsis of the work reported is as follows:

The orchard and fruit garden.
Tests of vegetable novelties.
The Station arboretum.
Experiments with insecticides.
Experiments with fungicides.
The potato—a test of varieties and report of experiments.
The influence of the depth of tillage upon the depth of roots.
Experiments in the cultivation of corn.
The influence of thorough as contrasted with slack preparation of soil.
Investigations in soil physics.

THE ORCHARD AND FRUIT GARDEN.

Additions to the lists of fruits. Notes on bearing varieties.

ADDITIONS TO THE LISTS OF FRUITS.

Believing that the extensive pomological interests of our State are entitled to a greater share of attention from our Station than they have heretofore received, it has seemed wise to extend this department of our work. While there are several directions in which this might be done, the one that seemed most urgent was the enlarging of the variety tests, inasmuch as considerable time is required to establish a bearing plantation of the larger fruits. The limited tests of fruits made in the past have shown that enterprising fruit growers are very generally interested in comparative trials of the more recently introduced varieties.

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* Emmett S. Goff.

Although in the greater part of our State the winters are not so severe as to necessitate the selection of the so-called iron-clad fruits, in our northern counties, which lie in the latitude of central Wisconsin, experience has shown that only the hardier sorts can be successfully fruited. On this account it has seemed wise to test the so-called Russian varieties, as well as the less known native sorts.

The question as to the method of securing the newer varieties had to be considered. Many of these are advertised to a considerable extent before the plants are offered for sale. The proprietors of supposed new and valuable varieties are often unwilling to place them at a public place like an experiment station, where the plants are liable to dissemination. On the other hand, the Station should hardly be expected to pay the extravagant prices charged for novelties and then be restricted as to their privileges with them. As the originators or proprietors of new fruits are the ones chiefly interested in their introduction, it seems proper that they should furnish the plants to the Station, and as the object of the Station tests is the information of fruit growers and not the distribution of plants, it is quite right that the proprietors of new fruits should be protected against dissemination from the Station. The following circular was therefore sent to as many proprietors of new fruits as could readily be reached:

NEW YORK AGRICULTURAL EXPERIMENT STATION,
GENEVA, *January* 3, 1888.

It is proposed to make the testing of new fruits a special feature of the horticultural department of this Station in the future, in order that all persons interested in fruit culture may be enabled to see and compare the newer varieties growing under, as nearly as can be secured, equal conditions. A portion of the Station grounds well adapted to fruit has been set apart and will be reserved for this special purpose. The soil will be kept well fertilized and the culture given will be first class. Accurate notes will be kept on all points that have a near or remote interest to the fruit grower, such as the time of maturity, yield, size, color, firmness, flavor, keeping quality, etc., of the fruit; the vigor and hardiness of the plant or tree, the attacks of insects or disease, the date at which the leaves and flowers appear, etc. This information will be published from time to time for the information of the public, either in the form of bulletins or in the annual reports of the Station, and a copy of such bulletin or report will be mailed free of cost, and without application, to all who have contributed one or more varieties desired for trial. Thus each contributor will be informed not only of the merits of his own variety, under the conditions of our trial grounds, but also, of those of all other varieties under test.

The advantages of such a trial station for the newer varieties of fruit, both to the introducers and the public must be obvious to all. It enables the former to place their new varieties where they are certain to receive proper treatment, where they are seen by many fruit growers, and where their exact merits, as compared with those of other varieties under the same conditions, will appear. It enables the latter to examine for themselves the real qualities of different varieties under the conditions of our trial grounds, or to those who are unable to visit our Station, it offers an opportunity of securing precise data concerning any variety on trial, with the assurance that all testimony is disinterested.

Only such varieties are desired as are not already in possession of the Station, have not been already well tested, and as are fully believed by their originators or proprietors to be worthy of general introduction. Varieties that are being propagated for introduction, but which have not yet been offered for sale, are especially desired, in order that the results of our tests may be available to the public as early as possible.

It is very desirable that a brief historical statement accompany all varieties sent. If the variety is known to be a cross, or a hybrid, the fact should be stated, and the names of the male and female parents should be given if known. In the larger fruits the stock on which the variety has been worked should be stated, also the age of the specimens sent.

It is understood that the plants or trees of all varieties sent for trial are the exclusive property of the Station for trial purposes, but not for dissemination. In the case of grape vines, however, the surplus wood will be returned to the proprietor for a limited time, at his expense, if this is desired.

The Station will reserve the right to exchange any surplus plants, trees, cions, buds or cuttings of any variety sent for trial with any other experiment station established under national or state laws, provided the proper restrictions are agreed to by that institution. In no other case will any variety be knowingly permitted to leave the trial grounds of the Station, unless special permission is secured from the donor. The Station will assume no responsibility, however, in case of theft, though all reasonable care will be taken to prevent it.

All varieties accepted will be acknowledged in the annual report for the year in which they are received.

In the apple, cions or trees will be accepted, though cions are preferred. In the other large fruits, trees are preferred, though in the pear, cions or buds will be acceptable.

In the strawberry, the smallest number of plants upon which a full report will be made will be twenty-four, and five in the raspberry, blackberry, currant and gooseberry. In the grape and in the tree fruits, two plants of a variety will be the standard number for trial.

It is requested that all who contemplate sending one or more varieties for trial will notify the Director of the Station as early as convenient.

Respectfully.

PETER COLLIER, *Director.*

This circular* met with very generous responses, and by its means the following varieties were added to those previously on trial at the Station. In cases when our list of the more standard sorts was deficient, old varieties were accepted on the same terms as new ones.

Apple.

Arctic.
August.
Bailey Sweet.
Benoni.
Blood Red.
Canada Baldwin.
Canada Reinette.
Chicago.

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*The names of those who responded to our circular, as well as the fruits furnished, will be found in our list of donors in this report.

Clark.
Cogswell.
Colvert.
Dartmouth.
Delaware Red Winter.
Delaware Winter.
Dickinson.
Early Colton.
Early Ripe.
Ewalt.
Excelsior.
Fanny.
Flora.
Gideon.
Gideon Sweet.
Golden Medal.
Gracie.
Hartford Rose.
Haskell Sweet.
Holland Pippin.
Indian.
Jacobs' Winter Sweet.
Jonathan.
Landon.
Lankford.
Late Duchess.
Lord Nelson.
Low.
Magog Red Streak.
Mann.
Martha.
McIntosh Red.
McMahan White.
Milding.
Milligen.
Missouri.
Montreal Beauty.
Mosher Sweeting.
Nodhead.
North Western Greening.
Ohio Beauty.
Ohio Pippin.
Palmer Greening.
Paul's Imperial.
Peach.
Peter No. 6.
Picta Stricta.
Pound Sweet.
Princess Louise.
Salome.
Sankermanky.
Schiawasse Beauty.
Scott's Winter.
September.
Smith's Cider.
Stark.
Summer Rose.
Swaar.
Tobias Apple.
Tobias Black.
Tobias Pippin.
Van Wyck.
Victoria Sweet.
Walbridge.
Washington Strawberry.
Wealthy.
Winter Queen.
Wolf River.
Yellow Forest.
Yellow Transparent.
York Imperial.
No. 1 Sweet (Gideon).
No. 2 Sweet (Gideon).
No. 3 Sweet (Gideon).
No. 30 (Gideon).

Russian Varieties.

Aport Oriental.
Arabian, No. 184.
Autumn Streaked, No. 964.
Babusschino, No. 469.
Belle de Boskoop.
Bogdanoff.

Borsdorf, No. 341.
Charlottenthaler, No. 342.
Cut Wine, No. 210.
English Pippin, No. 507.
Enormous, No. 398.
Glass Green, No. 187.
Golden White, No. 978.
Heidvon, No. 164.
Howard's Aport.
Juicy Cream Tartar, No. 563.
Longfield, No. 161.
Landsberger Reinette.
Melonen, No. 568.
No. 7 (Gideon).
No. 21, Vorenesh.
No. 30 (Gideon).
Prolific Sweeting, No. 351.
Rash des Venskoe, No. 477.
Raspberry, No. 288.
Romenskoe, No. 599.
St. Peters, No. 372.
Scvitzer, No. 304.
Smelling Apple, No. 264.
Sugar Barbel, No. 368.
Summer Red Calville, No. 182.
White Pigeon, No. 317.
Titus of Vorenesh.
Zolototorreff, No. 275.

Crab Apple.

Currant.
Lady.
Large Red Siberian.
Marengo.
Minnesota.
Red Siberian.
Yellow Siberian.

Pear.

Angouleme.
Anjou.
Anna Nelis.
Bartlett.
Beacon.
Belle Lucrative.
Beurre de l'Assumption.
Bordeaux.
Bosc.
Boussack.
Brandywine.
Brignais.
Brockworth Park.
Buffum.
Clairgeau.
Clapp's Favorite.
Comet.
Congress (Souvenir de Congress.)
Craig.
Dana's Hovey.
Dearborn.
Directeur Alphand.
Dr. Hoskins.
Dr. Reeder.
Easter Beurre.
Fortune Boisselet.
Gans.
Gansel's Seckel.
Giffard.
Goodale.
Grand Isle.
Hardy.
Howell.
Josephine of Malines.
Lawson.
Lawrence.
Le Conte.
Little Gem.
Louise Bonne of Jersey.
Manning's Elizabeth.

Marshall.
Madame Millet.
Mount Vernon.
Osband's Summer.
Pitmaston Duchesse.
Pound.
Refreshing.
Rutter.
Seckel.
Sheldon.
Souvenir d'Esperen.
Summer Doyenne.
Superfin.
Tyson.
Van Cott.
Urbaniste.
Winter Nelis.

Russian Varieties.

Bezi de la Motte.
Crassane Bergamotte.
Moscow, No. 4.
Peffer, No. 3.
No. 122.
No. 345.
No. 347.
No. 358.
No. 392.
No. 396.
No. 418.
No. 439.
No. 506.
No. 513.
No. 520.

Plum.

Belle de September.
Botan.
Burbank.
Copper.
Czar.
De Caradeuc.
Early Orange Prune.
French Damson.
Golden Gage.
Grand Duke.
Guii.
Hudson River.
Hudson River Purple Egg.
Huling's Superb.
Ickworth Imperatrice.
Imperial Gage.
Improved Green Gage, or Tobias Gage.
Kingston.
LaFayette.
Mariana.
Middleburg.
Miner.
Monroe.
Moore's Arctic.
Niagara.
Ogden.
Oullin's Golden.
Prunus Simoni.
Quackenboss.
Robinson.
Royal Hative.
Satsuma.
Shipper's Pride.
Speckled Gage.
Stanton.
Strawberry.
Transparent.
Union Purple.
Wild Goose.
Yellow Gage.
Seedling of Mariana, No. 1.
Seedling of Mariana, No. 2.

Russian Varieties.

Arab, No. 1.
Arab, No. 2.
Arab, No. 3.
Communia.
De Soto.
Hungarian.
Merunka.
Rollingstone.
Wolf.

Cherry.

Arch Duke.
Brandywine.
Catskill.
Florence.
Kirtland's Mary.
Lithaner's Weichsel.
Louis Phillippe.
Luelling.
Lutovka.
Montmorency Large Fruited.
Murdock's Bigarreau.*
Ostheim.
Rostraver Bigarreau.*
Schmidt's Bigarreau.
White Caroon.
Wragg.
Yellow Spanish.

Peach.

Alberge Yellow.
Brevoort.
Chair's Choice.
Cooledge's Favorite.
Crockett's White.
Druid Hill.
Foster.
Garfield.
Globe.
Haine's Early.
Hill's Chili.
Kenrick's Heath.
Lady Ingold.
Malta.
Moore's Favorite.
Morris White.
Mountain Rose.
Myer's Seedling.
Princess of Wales.
Reeve's Favorite.
Rosier.
Royal George.
Royal Kensington.
Salway.
Schumaker.
Steven's Rareripe.
Steven's Late.
Surpasse Melocoton.
Thurber.
Wager.
Walburton's Admirable.
Willetts.
Yellow St. John.

Apricot.

Alexander.
Alexis.
Blenheim.
Catharine.
De Coulange.
Gibb.

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* From J. R. & A. Murdock, Pittsburg, Pa. Omitted from list of donors by mistake.

J. L. Budd.
New Large Early.
Nicholas
Orange.
Oullin's Early Peach.
Purple.

Quince.

Winter Sweet.

Grape.

Adirondack.
Aledo.
Amber.
Ambrosia.
Arnold's No. 1.
Arnold's No. 2.
Arnold's No. 16.
Beagle.
Beauty.
Black Eagle.
Brighton.
Clevener.
Clinton.
Concord Chasselas.
Cottage.
Creveling.
Croton.
Cynthiana.
Daisy.
Delaware.
Diana.
Dracut Amber.
Duchess.
Early Market.
Eldorado.
Elsinburgh.
Elvibach.
Elvira.
Etta.
Eva.
Faith.
Gærtner.
Geneva.
Gœthe.
Governor Ireland.
Grayson.
Grein's Golden.
Hartford.
Ideal.
Ives.
Janesville.
Jewell.
Little Blue.
Mable.
Marion.
Maxatawney.
Massasoit.
Mills.
Merrimac.
Metterney.
Montefiore.
Moore's Diamond.
Missouri Reissling.
Nectar.
Niagara.
Noah.
Northern Muscadine.
Norton.
Olita.
Oneida.
Pearl.
Perkins.
Poughkeepsie.
Profitable.
Rebecca.
Red Bird.

Red Eagle.
Roscoe.
Rommel.
Rustler.
Rutland.
Standard.
Telegraph.
Triumph.
Ulster.

Seedlings Not Named.

From A. J. Caywood & Son:
- No. 1.
- No. 16.
- No. 50.

From D. S. Marvin:
- No. 1.
- No. 2.
- No. 3.
- No. 4.

Rogers' No 5.
Rogers' No. 13.
Rogers' No. 24.
Rogers' No. 28.
Rogers' No. 32.
Rogers' No. 39.
Rogers' No. 41.
Rogers' No. 44.

Strawberry.

Banquet.
Belmont.
Bomba.
Bubach.
Bubach, No. 5.
Burt's Seedling.
Cardinal.
Carmichael.
Crawford.
Crimson Cluster.
Daisy.
Dawley.
Enhance.
Excelsior.
Farnsworth.
Foster's Seedling.
Garden.
Gold.
Hampden.
Haverland.
Henderson.
Hoffman Seedling.
Ivanhoe.
Jessie.
Jewell.
Lida.
Louise.
Mammoth.
New Dominion.
Ohio.
Pineapple.
Summit.
Warfield's No. 2.
Seedling, from J. & J. L. Leonard.
Seedling, No. 70, P. M. Augur & Sons.

Raspberry.

Ada.
Carman.
Champlain.
Crystal White.
Genesee.
Golden Queen.

Hale's Early.
Pioneer.
Pomona.
Rancocas.
Reliance.
Scarlet Gem.
Schaffer.
Spry's Early.
Thompson's Early Pride.
Thompson's Early Prolific.
Seedling, No. 2 (J. T. Macumber).

Blackberry.

Ancient Briton.
Barnard.
Dorchester.
Early Cluster.
Evergreen.
Kittatinny.
Lawton.
Lincoln.
Minnewaska.
Snyder.
Thompson's Early Mammoth.

Currant.

Prince of Wales (black).
Red Flowering.
Saunders, No. 1 (black).
Saunders, No. 2 (black).
Seedling (white), from A. J. Caywood & Son.

Gooseberry.

Crown Bob.
Crystal.
Pale Red.
Pearl.
Whitesmith.
Seedling, No. 1, from S. L. Dagwell.
Seedling, No. 2, from S. L. Dagwell.
Seedling, from L. Roesch.

Huckleberry.

Red.

The plants of most of these varieties made a good start the past season. As was to be expected, some failed. As they arrived at different times and were in different degrees of freshness when planted out, no report of their comparative vigor is offered at this time, as such a report could hardly be just until all have recovered from the shock of transplanting.

In order that those interested may be informed of the total number of varieties now under trial at the Station, a list of those secured previous to the past season is appended. Of this list, the larger fruits are just now coming into bearing. Of the smaller fruits, reports have already been made in previous volumes of the Station report, and additional data are given in the report of the Assistant Horticulturist in this volume.

VARIETIES ALREADY IN POSSESSION OF THE STATION.

Apple.

Summer Varieties.

Carolina June.
Early Harvest.
Early Strawberry.
Golden Sweet.
Keswick Codlin.*
Primate.*
Red Astrachan.*
Sops of Wine.
Sweet Bough.
Tetofsky.
William's Favorite.

Autumn Varieties.

Alexander.
Aunt Ginnie.*
Baldwin.
Blenheim Pippin.
Chenango.*
Fall Pippin.
Fall Wine.
Fameuse.*
Gravenstein.
Haas or Fall Queen.*
Hurlbut.*
Jefferis.*
Jersey Sweeting.*
Lord Suffield.*
Maiden's Blush.
Menagere.
Munson's Sweet.*
Oldenburg.*
Pumpkin Russet.
Red Bietigheimer.
St. Lawrence.
Stump.

Winter Varieties.

Amasia.
Ben Davis.*
Brownlee's Russet.*
Cooper's Market.*
Cox's Pomona.
Dominie.*
Downing's Winter Maiden's Blush.
Duke of Devonshire.
Dumelow's Seedling.*
Ella.
Esopus Spitzenburgh.
Fallawater.*
Golden Russet.
Green Newtown Pippin.*
Grimes Golden.
Hubbardston.
Lady Apple.
Lady Henniker.
Lady Sweet.
Melon.*
Mother.
Monmouth Pippin.*
Northern Spy.
Occident.
Ontario.*
Peck's Pleasant.
Pewaukee.*
Pomme Grise.*
Pumpkin Sweet.
Rambo.
Rawle's Janet.*
Red Canada.*
Red Russet.
Reinette a feuille d'Aucuba.*
Reinette de Caux.
Rhode Island Greening.*
Rome Beauty.*
Roxbury Russet.*
Small's Admirable.*

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* Fruited the past season.

Sutton Beauty.
Talman's Sweet.
Tompkins King.*
Tuft's.*
Twenty Ounce.*
Vandevere.*
Wagener.
Westfield Seek-No-Further.
White Pippin.*
Winesap.*
Yellow Bellflower.

Russian.

Ananarnoe.
Antonooskoe.*
Astravaskoe.*
Belborodooskoe.
Berkoff.
Count Orloff.
Grand Duke Constantine.
Grand Sultan.
Groskoe Selenke Grüner.*
Kalkidouskoe.
Karabowka.
Red Transparent.
Repka.*
Restchestwenskoe.*
Titouka.*
Workaroe.
Zarskischip.

Crab Apple.

Coral.*
Hyslop.*
Large Red Siberian.*
Oblong.*
Transcendent.*
Whitney's Seedling Siberian.*

Pear.

Andre Desportes.
Ansault.*
Beurre de l' Assomption.
De Lamartine.
Comice.
Duhamel du Monceau.
Fondante de Bihorel.
Frederic Clapp.
Henri Desportes.*
Hoosic.
Jacques Molet.
Jones Seedling.
Jules Bivort.*
Keiffer.
Madame Andre Leroy.
Madame Appert.
Madame Treyve.*
Marie Benoist.
Maurice Desportes.*
President Mas.
Raymond de Montlaur.
St. Crispin.
Theresa Appert.

Peach.

Alexander's Early.
Alexandra.
Amsden.
Beatrice.
Conkling.
Crawford's Early.
Crawford's Late.
Early Silver.
Early York.
Foster.

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* Fruited the past season.

George IV.
Goshawk.
Hale's Early.
Large Early York.
Lord Palmerston.
Louise.
Magdala.
Mrs. Brett.
Nectarine.
Oldmixon Clingstone.
Oldmixon Freestone.
Red Cheek Melocoton.
River's Early York.
Saunders.
Shanghai.
Snow Peach.
Stump the World.
Ward's Late.
Waterloo.
Wheatland.
Wilder.

Plum.

Bavay's Green Gage.*
Bradshaw.
Bryanston's Gage.*
Coe's Golden Drop.
Duane's Purple.
General Hand.*
German Prune.
Goliath.
Green Gage.
Imperial Gage.
Italian Prune.
Jefferson.
Lombard.*
Lucombe's Nonesuch.
McLaughlin.*
Newman.
Orange.
Peter's Yellow Gage.*
Pond's Seedling.
Prince Englebert.*
Prune d'Agen.
Saint Lawrence.
Shropshire Damson.
Smith's Orleans.
Victoria.
Wangenheim.
Washington.
Weaver.
Yellow Egg.
Yellow Gage.

Cherry.

Belle Magnifique.
Bigarreau.
Black Eagle.
Black Tartarian.
Cleveland's Bigarreau.
Coe's Transparent.
Downer's Late.
Early Purple.
Elton.
Eugenia.
Flemish.
Governor Wood.
Kentish.
Knight's Early.
Late Duke.
Leib.
May Duke.
Meyel.
Montmorency Ordinaire.
Morello (English).*
Napoleon Bigarreau.
Olivet.

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* Fruited the past season.

Reine Hortense.
Rockport Bigarreau.
Royal Duke.
Sparhawk's Honey.
Tradescant's Black Heart.
Windsor.

Quince.

Champion.
D'Alger.*
De Constantinople.*
Rea.

Nectarine.

Boston.
Downton.
Early Newington.
Early Violet.
Elruge.
Late Melting.
Lord Napier.
Milton.
Newton.
Pitmaston Orange.
River's Orange.
Spencer.
Stanwick.
Victoria.

Apricot.

Black.
Breda.
Canino Grosso.
Early Golden.
Early Moorpark.
Hemskirke.
Kaisha.
Large Early.
Large Early Montgamet.
Malcolm's Breda.
Montgamet.
Moorpark.
Peach.
Red Masculine.
Royal.
Sardinian.
St. Ambroise.
Shipley's.
Turkey.

Blackberry.

Agawam.
Crystal White.
Early Cluster.
Early Harvest.
Stayman's Early.
Stone's Hardy.
Taylor's Prolific.
Wilson's Early.
Wilson Junior.

Dewberry.

Bartell's.
Lucretia.
Mammoth.

Gooseberry.

Downing.
Houghton's Seedling.
Industry.
Mountain Seedling.
Smith's.

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* Fruited the past season.

Currant.

Baldwin's Black.
Black English.
Black Naples.
Cherry.
Fay's Prolific.
Glorie des Sablons.
Lee's Black Prolific.
London Red.
Missouri Large Fruited.
Missouri Sweet Fruited.
Ogden's Black Grape.
Prince Albert.
Red Dutch.
Short Bunched Red.
Victoria.
White Dutch.
White Grape.

Grapes.

Agawam.*
Amber Queen.*
August Giant.
Bacchus.
Barry.*
Black Madeira.
Brighton.*
Burnet.*
Catawba.*
Champion.*
Concord.*
Duchesse.*
Early Victor.*
Eaton.
Empire State.
Eumelan.*
Francis B. Hayes.*
Green Mountain.*
Highland.*
Iona.*
Isabella.*
Jefferson.*
Jessica.*
Lady.*
Lady Washington.*
Lindley.*
Mary.*
Marvin's Centennial.*
Monroe.*
Moore's Early.*
Niagara.*
Norwood.
Oriental.
Pocklington.*
Poughkeepsie.*
Prentiss.*
Rochester.*
Salem.*
Senasqua.*
Ulster Prolific.*
Vergennes.*
Wilder.*
Woodruff Red.*
Worden.*
Wyoming Red.

Raspberry.

Brandywine.
Caroline.
Crimson Beauty.
Cuthbert.
Erie.
Gregg.

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* Fruited the past season.

Hansell.
Herstine.
Johnson's Sweet.
Key's Prolific.
Lost Rubies.
Mammoth Cluster.
Marlboro.
Meredith Queen.
Miller's Woodland.
Montclair.
Naomi.
Nemaha.
Ohio.
Orange.
Palmer's Seedling.
Philadelphia.
Reder.
Silver Queen.
Souhegan.
Superb.
Turner.

Strawberry.

Belle de Bordelaise.
Bidwell.
Beuchley's Seedling.
Charles Downing.
Cornelia.
Covill's Early.
Crescent.
Cumberland.
Daisy Miller.
Daniel Boone.
Excelsior.
Garretson.
Golden Defiance.
James Vick.
Jersey Queen.
Jucunda,
Jumbo.
Kentucky.
Legal Tender.
Lennig's White.
Longfellow.
Manchester.
May King.
Miami.
Montreuil.
Mount Vernon.
Mrs. Garfield.
Old Ironclad.
Ontario.
Parry.
Piper's Seedling.
Primo.
Prince of Berries.
Red Alpine.
Royal Hautbois.
Sharpless.
Triomphe de Gand.
Wilson.
Woodruff No. 1.

The Station is still as glad to receive new varieties for trial, under the terms above stated, as ever, and any readers of this report who may have promising new seedlings of fruits adapted to our climate are invited to send sample plants of the same the coming spring, or at any future time.

NOTES ON BEARING VARIETIES.*

The varieties of the larger fruits (including the grapes), in the latter list which are marked with a star, bore more or less fruits the past season.

The Apple.

The apples were, with a few exceptions, top-grafted on Baldwin stocks in the spring of 1883. Unfortunately for the trees, the soil is in poor condition, having been in grass ever since the spring of 1883, and a crop of hay has been removed each summer, while very little fertilizer has been applied. The trees almost all blossomed well last spring, but a very luxuriant growth of grass was removed in June, and but a small part of the fruits matured. The Jersey Sweeting, Dominie, Rome Beauty, Tuft's and Antonooskoe bore a fine crop for the size of the trees; the Red Astrachan, Keswick Codlin, Primate, Ben Davis, Rawle's Janet, Roxbury Russet, Dumelow's Seedling, Small's Admirable, and Groskoe Salenke Grüner, bore a fair crop; others marked as having borne, yielded but a few specimens each. Among the crabs, the Hyslop's, Large Red Siberian and Transcendent bore well, the Coral and Oblong bore a small crop, while the Whitney's Seedling Siberian yielded but a few specimens.

The Pear.

The five pear trees marked as having borne fruit were set in the spring of 1884. Of these, the Henri Desportes and Jules Bivort bore a large crop for the size of the trees, the Maurice Desportes bore a fair crop, while the other two yielded a few specimens each.

The fruit of the Henri Desportes was medium to large, greenish yellow, a little russet about the calyx, with numerous minute brown dots, and (using Mr. Downing's terms) obovate obtuse pyriform; cavity small, open, a little one-sided; calyx small and open, in a deep and rather narrow furrowed basin; flesh whitish, decidedly coarse-grained, but sweet and pleasant; ripe about September 20.

That of the Jules Bivort was of medium size; yellowish green, with some patches of russet and a blush toward the sun; thickly sprinkled with grayish brown dots, the latter becoming dull red on the side toward the sun; form globular obtuse pyriform, stalk one to one and a fourth inches long, generally set a little one-sided in a very small cavity; calyx open, in a very narrow and shallow regular basin; flesh greenish white, becoming white at the center, coarse in the part bordering the carpels, very juicy, sweet, rich and pleasant; ripe about October 20.

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*For data in relation to the small fruits, see Report of the Assistant Horticulturist.

The Plum.

The plum trees that blossomed were treated to the jarring process nearly every morning for two weeks after the petals commenced to fall, but for some reason the plums mostly fell off before maturity. As the trees were quite small, a sufficient number of the curculios probably escaped destruction to puncture the majority of the few fruits set.

The Cherry.

Our record does injustice to the cherry trees, as many of these would have ripened fruits but for the fact that the cherries were taken before maturity by birds. The trees stand below the apple orchard and near the brook, where they are quite out of view from the office and very convenient to the birds. Being quite small as yet, the birds were able to appropriate the crop before the cherries were fully ripe.

The Grape.

The vines of the varieties here reported on have been set at various times from the spring of 1883 to that of 1887, and, as will appear by comparison with our last report,* several of the varieties bore the past season for the first time. The following notes were taken as to date of maturity, yield, growth, etc.:

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*See report New York Agricultural Experiment Station, 1887, page 341.

GRAPE — DATA AS TO VARIETIES.

	First leaves appeared.	First flowers opened.	First fruits ripe.	Last leaves falling.	Yield.	Growth.	Remarks.
Agawam	May 19	June 19	**Sept. 27**	Oct. 27	Fair	Very good	A little mildew.
Amber Queen	May 21	June 18	**Oct. 14**	Oct. 29	Fair	Good	Traces of mildew.
Barry	May 14	June 18	**Sept. 20**	Nov. 7	Large	Very good	Traces of mildew.
Brighton	May 14	June 21	**Sept. 20**	Nov. 7	Fair	Very good	Traces of mildew.
Burnet	May 21	June 21	**Sept. 26**	Oct. 29	Small	Good	Considerable mildew.
Catawba	May 19	June 21	**Oct. 30**	Oct. 29	Fair	Good	No mildew.
Centennial	May 16	June 21	**Sept. 27**	Oct. 29	Very large.	Feeble	Much mildew; some damage from thrips.
Champion	May 14	June 16	**Sept. 10**	Nov. 7	Fair	Very good	No mildew.
Concord	May 23	June 21	**Sept. 25**	Nov. 7	Large	Rather feeble.	No mildew.
Duchess	May 21	June 21	**Sept. 30**	Nov. 7	Fair	Good	No mildew.
Early Victor	May 22	June 22	**Sept. 20**	Nov. 7	Fair	Good	Foliage injured by thrips.
Eumelan	May 14	June 21	**Sept. 14**	Oct. 29	Large	Feeble	Traces of mildew.
Green Mountain	May 14	June 19	**Sept. 1**	Nov. 7	Large	Good	Traces of mildew.
Hayes	May 14	June 21	**Sept. 20**	Nov. 7	Small	Good	No mildew.
Highland	May 21	June 21	....	Oct. 27	Large	Feeble	No mildew.
Iona	May 23	June 21	**Oct. 14**	Nov. 10	Fair	Good	A little mildew.
Isabella	May 21	June 19	**Oct. 11**	Nov. 10	Fair	Good	No mildew.
Jefferson	May 23	June 21	**Sept. 27**	Nov. 10	Fair	Good	Some mildew.
Jessica	May 23	June 19	**Sept. 14**	Nov. 7	Large	Good	Traces of mildew.

GRAPE — DATA AS TO VARIETIES.— (*Continued*).

	First leaves appeared.	First flowers opened.	First fruits ripe.	Last leaves falling.	Yield.	Growth.	Remarks.
Lady	May 25	June 23	**Sept. 20**	Nov. 7	Fair	Feeble	No mildew.
Lady Washington	May 22	June 22	**Oct. 20**	Nov. 7	Small	Very good	Traces of mildew.
Lindley	May 21	June 21	**Sept. 23**	Oct. 29	Fair	Good	No mildew; some damage from thrips.
Mary	May 14	June 21	**Sept. 24**	Oct. 29	Fair	Good	No mildew.
Monroe	May 21	June 21	**Sept. 10**	Nov. 7	Fair	Good	Considerable mildew.
Moore's Early	May 20	June 21	**Sept. 10**	Oct. 29	Large	Good	No mildew.
Niagara	May 15	June 21	**Sept. 19**	Nov. 8	Large	Good	No mildew; slight damage from thrips.
Pocklington	May 23	June 19	**Oct. 5**	Nov. 7	Fair	Feeble	Traces of mildew.
Poughkeepsie	May 21	June 21	**Sept. 14**	Oct. 29	Fair	Feeble	Traces of mildew; some damage from thrips.
Prentiss	May 21	June 22	**Sept. 24**	Oct. 29	Small	Feeble	No mildew; some damage from thrips.
Rochester	May 19	June 19	**Aug. 31**	Oct. 27	Large	Good	Some mildew.
Salem	May 14	June 19	**Sept. 25**	Oct. 27	Fair	Good	Some mildew.
Senasqua	May 23	June 23	**Sept. 21**	Nov. 12	Small	Feeble	Some mildew.
Ulster Prolific	May 13	June 18	**Oct. 5**	Oct. 27	Large	Feeble	Traces of mildew.
Vergennes	May 21	June 21	**Sept. 20**	Oct. 29	Large	Very good	Traces of mildew.
Wilder	May 21	June 19	**Sept. 24**	Oct. 29	Fair	Very good	Some mildew.
Woodruff Red	May 21	June 19	**Oct. 5**	Oct. 29	Fair	Very good	Traces of mildew.
Worden	May 24	June 22	**Sept. 20**	Nov. 7	Fair	Very good	No mildew.
Seedling from J. G. Burrows	May 21	June 22	**Sept. 18**	Oct. 29	Large	Good	No mildew.

Seedlings from T. V. Munson:							
No. 20	May 22	June 21	**Oct. 6**	Oct. 29	Large	Good	Traces of mildew.
No. 20½	May 22	June 21	**Sept. 24**	Oct. 29	Fair	Good	No mildew.
No. 21	May 14	June 21	**Sept. 21**	Oct. 27	Fair	Good	No mildew.
No. 22	May 14	June 21	**Sept. 27**	Oct. 27	Small	Good	No mildew.
No. 24	May 22	June 25	**Sept. 24**	Oct. 27	Small	Good	No mildew.

Among the earlier new grapes the Green Mountain appears to be quite promising. The fruit ripened earlier than that of any other, with the exception of the Rochester. It is a whitish green grape, and the vine is vigorous and productive. The bunch is medium to large, rather long and slender, moderately compact, sometimes shouldered; the berry is a little larger than that of the Delaware, with a thin skin, which is dotted over the surface with minute reddish dots; seeds two to four, very small; flesh tender to the center, very sweet and pleasant, with a slight vinous flavor.

Descriptive notes have been made of nearly all of the varieties. As most of them have already been described, either in recent horticultural works or in the horticultural press, it is not thought necessary to publish the descriptions as made at the Station. Partial descriptive notes are, however, added for the six unnamed seedlings at the latter end of the table.

Seedling from J. G. Burrows. This vine, which bore for the first time the past season, appears to be vigorous and very productive. The bunch was medium to large, compact; berries rather small, bluish black, free from foxiness, and tender to the center; flavor mild and delicate.

Seedling from T. V. Munson. No. 20. Berries of medium size, of a beautiful yellowish green, with some chocolate-colored dots, flavor very mild and delicate.

No. $20_{\overline{2}}$. Berries medium to small, greenish yellow, with a few chocolate-colored spots; seeds, two or three, of medium size; flavor delicate, sweet and rich.

No. 21. Berries medium, of a beautiful, brilliant red, with a thin bloom; seeds, two or three, rather large; skin thin; flavor slightly vinous, mild and pleasant.

No. 22. Berries medium, greenish yellow, with a few minute reddish spots; seeds, one to three, small; flavor exceedingly pleasant and vinous.

No. 24. Berries medium, dark maroon, with a thin bloom; thin skin; seeds, two to four, rather small; flavor very sweet and pleasant.

All of the seedlings from Mr. Munson bore the past season for the first time. The vines were planted in a corner of the orchard, where the soil was decidedly poorer than that on which those of the named varieties stand. Probably on this account the bunches on all of them were quite small. In all, the berries ripened before frost, the flesh was tender to the center and quite free from foxiness or harshness. Indeed, I think the quality of them all would be considered first-class.

TESTS OF VEGETABLE NOVELTIES.*

The tests of vegetables made the past season have been chiefly limited to those bearing new names and advertised as specially desirable by one or more of the leading seedsmen of our country. The usual statistical data of the varieties are presented with brief descriptions so far as our notes permit.

EXPLANATION OF ABBREVIATIONS.

In order to economize space, abbreviations are used for the names of seedsmen and others in noting the source of the seeds planted. These abbreviations are here explained :

Ansley.— A. H. Ansley & Sons, Milo Center, Yates Co., N. Y.
Bailey.— Prof. L. H. Bailey, Jr., Agricultural College, Mich.
Basom.— Chas. Basom, Indian Falls, N. Y.
Batch.— Daniel Batchelor, Utica, N. Y.
Beyer.— Hugo Beyer, New London, Ia.
Bragg.— B. L. Bragg & Co., Springfield, Mass.
Cleve.— A. B. Cleveland, Cape Vincent, N. Y.
Dreer.— Henry A. Dreer, 714 Chestnut st., Philadelphia, Pa.
D. of A.— Department of Agriculture, Washington, D. C.
Evt.—J. A. Everitt & Co., Indianapolis, Ind.
Ely.—Z. De Forest Ely & Co., 1303 Market st., Philadelphia, Pa.
Ferry.— D. M. Ferry & Co., Detroit, Mich.
Finch.— Frank Finch, Clyde, N. Y.
Greg.— J. J. H. Gregory, Marblehead, Mass.
Hal.—V. H. Hallock, Son & Thorpe, Queens, N. Y.
Hen.— Peter Henderson & Co., 35 and 37 Cortlandt st., New York.
Ia. S. Co.— Iowa Seed Co., Des Moines, Iowa.

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*The word "novelties" is here used in the seedsman's sense. Experience has shown that the seedsman's novelties, so called, are not always novel.

Liv.— A. W. Livingston's Sons, Columbus, Ohio.

Maule.— Wm. Henry Maule, Philadelphia, Pa.

P. & R.—Price & Reed, Albany, N. Y.

Powell.— E. P. Powell, Clinton, N. Y.

Raw.— W. W. Rawson & Co., Boston, Mass.

S. & N. S. Co.— The Specialty and Novelty Seed Co., Newton-le-Willows, Lancashire, England.

Sib.— Hiram Sibley & Co., Rochester, N. Y.

Sta.— Seeds grown at this Station.

Thor.— Jas. M. Thorburn & Co., 15 John st., New York.

Till.— I. F. Tillinghast, La Plume, Pa.

Va'gh'n.—J. C. Vaughan, 146-8 West Washington st., Chicago, Ill.

Vick.— Jas. Vick, Rochester, N. Y.

Vil.— Vilmorin, Andrieux et Cie, 4 Quai de la Mégisserie, Paris, France.

Wilson.— Samuel Wilson, Mechanicsville, Bucks county, Pa.

THE BEAN.

Seeds of the list of beans named in the table below were planted in the Station garden May 28, one drill of each twelve feet long, the drills three and one-half feet apart.

BEAN — A TEST OF VARIETIES.

NAME.	Seeds from	First bloom.	Fit for table use.	First ripe seed.	Last ripe seed.	Number of pods per 100 plants.	Number of beans per 100 pods.	Tot'l weight of beans per 100 plants.	
DWARF BEAN.								Lbs.	Ozs.
Black Prolific Tree	Ansley	July 14	Aug. 5	Sept. 4	....	3,908	292	3	½
Boston Favorite	Bragg	July 14	Aug. 25	Aug. 29	Sept. 14	1,077	315	6	15¾
Detroit Wax	Ferry	June 30	July 17	Aug. 13	Aug. 30	883	307	2	13½
Dwarf Early Fleuriel	Vil	July 14	July 31	Aug. 25	Sept. 14	794	357	1	9
Dwarf French	S. & N. S. Co	July 29	July 17	Aug. 6	Aug. 25	1,033	382	2	11¼
Dwarf Pride of Lyons	Vil	July 29	July 23	Aug. 11	Aug. 27	1,132	420	4	¼
Early Carmine-podded Dwarf	Greg	July 28	July 14	Aug. 11	Aug. 27	613	385	2	2½
Emperor William	Hen	July 29	July 23	Aug. 11	Aug. 27	637	390	1	6¾
Extra Early Six Weeks	D. of A	July 30	July 14	Aug. 6	Aug. 27	816	369	2	14¾
Flageolet King of the Greens	Vil	July 3	July 23	Aug. 13	Aug. 25	1,439	375	2	9¾
Golden-pod Yellow-eyed Wax	Raw	July 1	July 16	Aug. 8	Aug. 14	1,019	362	1	11¾
Gray Succession	Vil	June 29	July 16	Aug. 8	Aug. 27	1,084	384	3	9¾
Green-seeded Bagnolet	Vil	July 3	July 23	Aug. 14	Aug. 25	1,545	307	2	1
Improved Red Valentine	Cleve	July 3	July 24	Aug. 13	Aug. 27	1,376	417	3	10¼
Low's Champion	Bragg	July 3	July 28	Aug. 25	Sept. 10	654	417	2	15½
New Prolific Black Wax	Greg	June 28	July 16	Aug. 13	Aug. 30	1,414	306	3	1¾
New Prolific German Wax	Vick	July 1	July 14	Aug. 13	Aug. 27	1,581	369	3	15
Queen of France	Vil	July 14	July 25	Sept. 2	Sept. 20	928	384	4	2¾

BEAN — A TEST OF VARIETIES.—(*Continued*).

NAME.	Seeds from	First bloom.	Fit for table use.	First ripe seed.	Last ripe seed.	Number of pods per 100 plants.	Number of beans per 100 pods.	Tot'l weight of beans per 100 plants.	
								Lbs.	Ozs.
Snowflake	Greg	July 13	July 30	Aug. 18	Aug. 25	1,414	464	2	11
Tree	Basom	July 23	Aug. 3	Aug. 25	....	1,812	344	3	½
White Crease Back	Evt	July 10	July 23	Aug. 11	Aug. 27	1,195	483	2	15¾
XX Dwarf	Maule	July 21	Aug. 3	Sept. 2	Sept. 20	1,244	367	4	12¼
POLE BEAN.									
Best of All	Wilson	July 31	Sept. 4	Sept. 29	....	2,491	......	....	
Early Morning Lima	Hal	July 16	July 4	Sept. 24	....	754	247	4	14⅛
Ford's Mammoth Long Pod	Liv	July 16	Sept. 4	Sept. 24	....	675	340	3	5¼
Kidney Cranberry	Sta	July 23	Aug. 5	Sept. 14	....	807	325	1	13½
New Early Golden Cluster	Wilson	Aug. 1	Aug. 6	Sept. 16	....	1,943	319	3	15¾
New White Runner	Powell	July 21	Aug. 2	Aug. 29	Sept. 17	1,500	213		1½
Bean received from Mr. Batchelor	Batch	July 16	July 25	Aug. 29	Sept. 14	1,060	493	3	9¾

DESCRIPTIVE NOTES.

Dwarf Beans.

Black Prolific Tree. Plant 12 inches high, with no tendency to run, habit quite compact; stem much branched; flowers pale purple; pods numerous, green at table size; beans oval, shining black, about $\frac{3}{8}$ inch long.

Boston Favorite. Plant 12 to 15 inches high, very vigorous; stem much branched; flowers very pale purple; pods very numerous, straight or a little recurved, often bent sidewise; the longer pods are 7 inches long and about $\frac{3}{4}$ inch wide; beans about $\frac{7}{8}$ inch long, pinkish white, irregularly striped and mottled with purplish red, with a light brown circle about the eye.

Detroit Wax. Plant about 10 inches high, compact, with no tendency to run; pods very numerous, golden yellow at table size, straight, or often curved sidewise, about $4\frac{1}{2}$ inches long and $\frac{7}{8}$ inch wide; beans 3 to 5 in a pod, rather large, short oval, white, with a peculiar shaped dark brownish-purple patch about the eye.

Dwarf Early Fleuriel. Plant 5 to 8 inches high, very compact; stem much branched; leaves finely blistered; flowers white; pods green at table size, strongly recurved, about 4 inches long and $\frac{1}{2}$ inch wide; beans very pale yellowish-brown, of medium size, very short oval, with a white or brown circle about the eye. The plants appear quite subject to mildew.

Dwarf French. Plant 7 to 10 inches high, compact, with no tendency to run; stem much branched; pods very numerous, green at table size, nearly straight, longer ones 5 inches long, $\frac{5}{8}$ inch wide, often not well filled; beans 2 to 5 in a pod, of a peculiar shade of brown, very uniform, of medium size, oval, considerably flattened. The foliage was much injured by mildew.

Dwarf Pride of Lyons. Plant 10 to 12 inches high, with no tendency to run; stem strong, erect, much branched, the branches inclining to erect; leaves finely blistered; pods very numerous, green at table size, slender, straight or recurved; beans 4 to 6 in a pod, medium to large, oblong kidney-shaped, rich purple, irregularly spotted with dirty white, the markings variable, about $\frac{7}{16}$ inch long.

Early Carmine Podded Dwarf. Plant 10 to 12 inches high; stem strong, much branched; leaves very large, often dishing; pods very numerous, large, green or faintly striped with red at table size, usually recurved, 3½ to 5 inches long, ⅝ to ¾ of an inch wide; beans 3 to 6 in a pod, rather large, short oval, dirty white, irregularly striped and mottled with bright purple, with a brownish circle about the eye.

Emperor William. Plant 10 to 12 inches high, compact; stem strong, thickly branched; leaves considerably blistered; pods numerous, green at table size, much curved sidewise, but otherwise nearly straight, broad and thin, 4 to 6 inches long, ⅞ inch wide; beans 5 or 6 in a pod, of medium size, white, oval, much flattened. The plants were much mildewed.

Extra Early Six Weeks. Plant 12 to 14 inches high, compact; pods numerous, green at table size, slender, straight or recurved, 5 or 6 inches long, ½ inch wide; beans 4 to 6 in a pod, rather large, light brown or greenish yellow, oblong, inclining to kidney-shape, with a rich brown circle about the eye.

Flageolet King of the Greens. Plant 9 to 12 inches high; foliage very deep, dull green, leaflets considerably puffed and blistered; stem much branched, pods numerous, green at table size, slender, usually recurved, 4 or 5 inches long; beans 4 to 6 in a pod, rather small, pale green, lavender or white, much flattened, oblong, squarish at one end, tapering slightly toward the other.

Golden Pod Yellow-eyed Wax. Plant 12 to 16 inches tall, erect, but with no tendency to run; foliage rather pale; stem much forked, branches erect; pods very numerous, beautiful golden yellow at table size, nearly straight, 4 to 5 inches long, $\frac{9}{16}$ inch wide; beans 4 to 6 in a pod, of medium size, considerably flattened, white, with a yellowish brown patch about the eye.

Gray Succession. Plant 12 inches high; foliage deep green, considerably puffed and blistered; branches of stem inclining to erect; flowers pale purple; pods numerous, slender, 6 or 7 inches long, generally rather strongly recurved; beans 5 to 7 in a pod, medium to large, oblong, inclining to kidney shape, blackish purple more or less mottled with dirty white.

Green Seeded Bagnolet. Plant 12 inches high; foliage deep green, considerably puffed and blistered; pods numerous, green at table size, slender, much curved, 4½ to 5½ inches long, ½ inch wide;

beans 3 to 5 in a pod, of medium size, white or greenish white, oblong kidney-shaped.

Improved Red Valentine. Plant 10 to 14 inches high, rather erect; foliage finely blistered; pods numerous, green at table size, narrow, but very thick and plump, about 5 inches long, ½ inch wide; beans 4 to 6 in a pod, medium to large, obscurely kidney-shaped, often somewhat squared at one end, dull red, with spots of dirty white shading in some samples to very pale brown.

Low's Champion. Plant 10 or 12 inches high, very vigorous and productive, not inclined to run; foliage very dark green, leaflets large, very much blistered; stem strong, much branched; flowers creamy white, tinged with rose; pods numerous, pale green at table size, somewhat recurved, thick, 3 to 5 inches long, ¾ inch wide; beans 3 to 5 in a pod, of medium size, purplish red, uniform, short, oval, thick.

New Prolific Black Wax. Plant 12 inches high; stem much branched, leaflets very large, considerably blistered; pods very numerous, strongly recurved, very plump, 4 or 5 inches long, ½ inch wide; beans 4 to 7 in a ped, of medium size, blue-black with a white eye, short oval.

New Prolific German Wax. This appeared identical with the above.

Queen of France. Plant 10 to 12 inches high, spreading, inclining to run; foliage deep green, considerably blistered; pods numerous, whitish green at table size, much curved, about 6 inches long, ½ inch wide; beans 4 to 6 in a pod, large, about ⅞ inch long, kidney-shaped, very much flattened, pinkish white, irregularly striped longitudinally with very dark brown.

Snowflake. Plants about 9 inches high; pods numerous, green at table size, narrow, nearly straight, about 4 inches long, ½ inch wide; beans 5 to 7 in a pod, very small, short, oval, pure white.

Tree (from Chas. Basom). Plant 12 to 15 inches high, very vigorous, inclined to run; foliage deep green, with large leaflets; stem strong, much branched; flowers white; pods numerous, whitish green at table size, slightly recurved, 3½ to 5 inches long, ½ inch wide; beans 4 to 6 in a pod, pure white, oval, about ⅜ inch long.

White Crease Back. Plant about 10 inches high, rather spreading, a little inclined to run; leaflets small, strongly blistered;

stem branching low; pods numerous, green at table size, plump, generally more or less recurved, 4 to 5½ inches long, ½ inch wide; beans 5 to 7 in a pod, small, white, kidney-shaped.

XX. Plant 18 inches high, remarkably vigorous; foliage deep green; leaflets very large, sometimes 6 inches long, 5 inches wide; stem strong, much branched; flowers very pale yellow, approaching white; pods numerous, green at table size, 4 to 6 inches long, ½ inch wide; beans 4 to 6 in a pod, of medium size, short oval, purple in the part surrounding the eye, pearly white, with translucent pencilings and dotted with purple in the remainder.

Pole Beans.

Best of All. Plant 3 to 4 feet high, very productive; foliage yellowish green; stem much branched; flowers white. Few of the beans ripened.

Early Morning Lima. Plant very vigorous, productive; foliage pale green, with large leaflets; stem strong, much branched; pods 4 to 6 inches long, 1 inch wide; beans greenish white, ovate, inclining to kidney-shaped, about 1 inch long. The pods did not all mature.

Ford's Mammoth Long Pod. Very similar to the above. The pods did not all mature.

Kidney Cranberry. Plant very vigorous and productive; foliage pale green, leaflets rather large; stem strong, considerably branched; flowers yellowish white, tinged with rose; pods whitish green at table size, strongly recurved, 4 to 6 inches long, ½ inch wide; beans 3 to 6 in a pod, of medium size, oval, dirty white, irregularly splashed and mottled with dark purple.

New Early Golden Cluster. Plant very vigorous, moderately productive; foliage deep green, with large leaflets; stem strong, much branched; pods not very numerous, cream-colored at table size, 4 to 6 inches long, ½ inch wide; beans 4 to 8 in a pod, rather small, oval, somewhat flattened, white, with translucent markings.

New White Runner. Plant not very vigorous but productive; foliage pale green, leaflets rather large; stem strong; flowers cream-colored; pods numerous, cream-colored at table size, somewhat recurved, 5 to 6 inches long, ⅝ inch wide; beans 4 to 6 in a pod, rather small, oval, light drab.

Bean from Mr. Batchelor. Plant vigorous and productive; foliage pale green; leaflets medium to large; stem much branched; pods numerous, cream-colored at table size, strongly recurved, 4 or 5 inches long, nearly ½ inch wide, almost cylindrical; beans 5 or 6 in a pod, of medium size, dark rich purple, short, oval.

Beside the varieties named, three were grown that proved so late that none of the pods attained sufficient size for table use. These were the Crimson King, from Mr. E. P. Powell; the Mammoth Tasmanian, from Hugo Beyer, and a Scarlet Runner, from the English Specialty and Novelty Seed Company.

THE BEET.

The varieties named were grown in the Station garden; one drill of each twelve feet long, the drills three and one-half feet apart. The seeds were planted April 25. The plants were thinned, when sufficiently large to require it, to six inches apart in the drill.

BEET — A TEST OF VARIETIES.

NAME.	Seeds from	Fit for table use.	Number of roots.	Average weight.
				Ounces.
Eclipse	D. of A.	June 25	18	26.1
Edmand's Blood Turnip	Va'gh'n	June 30	18	24.2
Fifty Day	Evt	June 23	19	36.2
Lentz Blood Turnip	Bragg	June 25	18	24.5
New Market Gardener's	Ia. S. Co.	June 29	13	40.0
Rawson's Arlington Favorite	Raw	June 25	16	32.6

DESCRIPTIVE NOTES.

Eclipse. Described in our report for 1887, page 122.

Edmand's Blood Turnip. Roots of medium size, very regular, shaped like those of the Early Blood Turnip. (Described Ibid, page 121.)

Fifty Day. Roots shaped somewhat like those of the Eclipse, but less regular.

Lentz Blood Turnip. Roots shaped like those of the Early Blood Turnip. Doubtfully distinct.

New Market Gardener's. Roots large, short conical, in form between that of the Eclipse and Half Long Blood; seed apparently somewhat mixed.

Rawson's Arlington Favorite. Resembled the Eclipse in its general characters.

THE CABBAGE.

Seeds of the following list of cabbages were planted in a well-prepared bed in the garden May 10. The young plants were kept from injury by the flea beetle, *Phyllotreta striolata* (Fabr.), by keeping the leaves dusted with land plaster, than which I know of no better preventive of damage from this insect. Twelve plants of each name were transplanted June 23, the plants being set two feet apart in rows three and one-half feet apart. The following data were noted:

CABBAGE — A TEST OF VARIETIES.

NAME.	Seeds from.	Number of plants.	Fit for table use.	Number of heads.	Average diameter.	Average weight.	
					Inches.	Lbs.	Ozs.
Chase's Excelsior	Liv	12	Sept. 4	12	9 2-10	5	9¾
Danish Bald-head Winter	Sib	12	Sept. 4	12	8 6-10	7	7¾
Extra Early Paris	D. of A.	12	Before Aug. 25	11	5 5-10	3	¾
Gregory's Hard Heading	Greg	12	Sept. 4	12	8 6-10	6	3¾
Henderson's Succession	Hen	12	Aug. 25	12	6 6-10	4	1¼
Improved Long Island Red	Hal	11	Sept. 20	12	6 9-10	4	2¾
Luxemberg	Va'gh'n	11	Sept. 12	12	8 1-10	4	3
Marvin's Savoy	Hal	12	Aug. 29	12	8 9-10	5	14
Rawson's Volunteer	Raw	12	Before Aug. 25	12	5 6-10	2	8¼
Reynold's Early	Greg	12	Aug. 29	10	8 4-10	4	12½
Sibley's Roch. Market Garden	Sib	11	Aug. 25	11	5 4-10	2	5¾
Vandergaw	Hal	11	Aug. 4	11	9	6	4¾

All of the varieties headed well, as the figures indicate. Through lack of time the descriptive notes were omitted. Among those deserving of special mention was Marvin's Savoy, of which the heads were very large and nearly as compact as those of the more solid smooth-leaved varieties.

THE CAULIFLOWER.

The following named cauliflowers were also grown, the treatment being the same in all respects as that noted for the cabbage. The varieties headed unusually well, with the sole exception of the one called "Early" from the English Specialty and Novelty Seed Company, which formed no heads.

CAULIFLOWER — A TEST OF VARIETIES.

NAME.	Seeds from	Number of plants.	Fit for table use.	Number of heads.	Average diameter.	Average weight.	
					Inchs.	Lbs.	Ozs.
Dreer's Earliest Snowstorm	Dreer	11	Sept. 24	8	7 8-10	3	15¼
Earliest Dwarf Erfurt	Va'gh'n	9	Sept. 6	5	6 9-10	3	9¾
Extra Early Dwarf Erfurt	Till	9	Sept. 29	4	6 4-10	2	14
Gilt-edge Snowball	Thor	12	Aug. 25	10	7 2-10	3	¾
Henderson's Early Snowball	Hen	12	Sept. 6	8	5 9-10	2	7½
Henderson's Early Snowball	Till	11	Sept. 14	8	5 7-10	2	15½
Long Island Beauty	Bragg	12	Aug. 25	11	7 2-10	2	9½
New Early Padilla	Till	11	Aug. 29	8	8 1-10	3	2

CORN — SWEET.

The sweet corns described below were planted May 22 on an inverted sod in good condition, in rows 3 feet apart each way.

Ballard's Early (Livingston). Fit for table August 6; ears 3 to 4 inches long, 8-rowed, white, on a white cob, lacking in sweetness; stalks about 3½ feet tall, ears 1 or 2 to the stalk, borne very low, often starting from the first node. Of little value aside from its earliness.

Creedmore (V. H. Hallock, Son & Thorpe). Fit for table August 27; ears 6 or 7 inches long, 2 inches in diameter, 10 or more rowed, white, on a white cob, produced abundantly, very sweet; stalks 6 feet tall, more or less tinged with purple, ears borne rather high. A good intermediate variety.

Extra Early Des Moines (Iowa Seed Company). Fit for table August 11; ears 5 to 7 inches long, 8 or 10-rowed, produced abundantly, white, on a white cob, not very sweet; stalks about

4 feet tall, leafy, somewhat washed with purple, ears borne very low.

Hawaii (Samuel Wilson). This variety germinated very poorly; the ears were fit for table August 30; 5 or 6 inches long, 10 or 12-rowed, white, on a white cob, produced in great abundance, often 3 or 4 to the stalk, rather sweet; stalks 4 feet tall, a little washed with purple, ears borne 12 to 18 inches high.

New Champion (Price & Reed). Fit for table August 13; ears 5 to 6 inches long, thick, 12-rowed, white, on a white cob, lacking in sweetness, but produced abundantly; stalks 3 to 4 feet high, strongly washed with purple, ears borne low.

New Perfection (Price & Reed). Fit for table August 8; ears 8 inches long, 10 or 12-rowed, white, with white cob, moderately sweet, produced in great abundance; stalks 3 to 4 feet tall, somewhat tinged with purple, ears borne about a foot high.

Northern Pedigree (J. C. Vaughan and Hugo Beyer). Fit for table August 9; ears 4 to 5 inches long, 8-rowed, white, with white cob, lacking in sweetness, borne abundantly; stalks 2 to 2½ feet tall.

The small ears and lack of sweetness of this variety render it practically worthless here, especially as it proved no earlier than others of better size and quality.

Ruby Sugar (W. W. Rawson). Fit for table August 30; ears about 6 inches long, very thick, bearing 14 or 16 rows, white at table size, remarkably sweet and borne abundantly; cob variable, sometimes white, at others red and at others purple; stalk 6 feet tall, blackish purple, ribs of the leaves purple, husks usually purple, but occasionally green; ears borne 2 to 2½ feet high.

This variety is of excellent quality, but the colored cob is objectionable. The juice of the purple cobs when the latter are boiled produces an almost indelible stain upon table linen.

CORN — POP.

The varieties described below were planted May 26, in rows 3½ feet apart, on excellent soil in the garden. Their popping qualities have not yet been tested.

California or Golden (Samuel Wilson). Remarkably productive, bearing 3 or 4 ears to the stalk, and all in the upper half;

ears about 3 inches long, strongly tapering, kernels of the rice type, but not in rows ; stalks 3½ to 4 feet tall. It matures rather late, and in many localities in our State would be in danger of injury from frost.

Golden Flake (Hiram Sibley & Co.). Ears 7 inch long, about 2 to the stalk, borne just above the center, 1½ inch in diameter at the butt, strongly tapering, 14 or 16-rowed, kernels roundish, rich yellow ; stalks 5 to 6 feet tall, somewhat tinged with purple in places. This is also quite late.

Page's New Striped Rice (Iowa Seed Company). Ears about 5 inch long, 1½ inch in diameter at the butt, strongly tapering, 1 or 2 to the stalk, borne about the center; kernels of the rice type, in irregular rows, beautifully striped with red and white ; stalks 4 to 5 feet tall, somewhat purple.

This was the earliest variety tested, the first ears ripening about September 17, and the last ones October 5.

Queen's Golden (W. W. Rawson). Ears about 6 inches long, 1½ inch in diameter at the butt, strongly tapering, borne about 2 to the stalk, above the center, 12 to 16-rowed, kernels roundish, bright yellow ; stalks 6 to 7 feet tall, mostly green throughout.

The earlier ears were ripe October 5.

THE CUCUMBER.

The cucumbers named below were planted in the garden May 24, one drill of each twelve feet long, the drills seven feet apart. The data noted appear in the table, no descriptive notes having been taken. The so-called Japan cucumber "Heshina" was interesting as a novelty, but appeared to have no special value.

CUCUMBER — A TEST OF VARIETIES.

NAME.	Seeds from	First bloom.*	Pickle size.	First ripe fruits.
Arlington	Liv	July 9	July 23	Aug. 25
Astro	Ia. S. Co	July 9	July 19	Before Aug. 25
Cardiff Castle (Fr'nch, vert long de Cardiff)	Vil	July 9	July 23	Before Aug. 25
Chicago Pickle	Liv	July 5	July 14	Aug. 5
Chinese Long Remaining Green	Dreer	July 5	July 20	Aug. 8
Extra Early Seedling	Thor	July 3	July 14	Aug. 3
Florida's Emerald	Thor	July 9	July 20	Sept. 14
Jewel	S. & N. S. Co	July 9	July 26	Sept. 14
New Giant Pera	Raw	July 9	....	Sept. 10
Nichols Medium Green	D. of A	July 7	July 15	Aug. 8
Paris Pickling	Va'gh'n	July 5	July 19	Aug. 8
Perfect White Spine	Ia. S. Co	July 5	July 16	Sept. 10
Thorburn's New Everbearing	Thor	July 3	July 18	Aug. 11
Westfield's Chicago Pickling	Va'gh'n	July 3	July 13	Aug. 3
White Japan	Ev't	July 3	July 16	....
Japan "Heshina"	Hal	July 28	Before Aug. 25	....

LETTUCE.

Seeds of the lettuces named below were planted in the Station garden April 25; one drill of each, twelve feet long, the drills three and one-half feet apart:

LETTUCE — A TEST OF VARIETIES.

NAME.	Seed from	Fit for table use.	First heads formed.	Running to seed.	First bloom.	First ripe seed.	Last ripe seed.
Bloomsdale Early Summer Creole	Hal	May 29	June 26	July 20	Aug. 14	Sept. 2	Oct. 5
Buttercup	Sta.	May 30	June 29	July 21	Aug. 14	Sept. 3	....
California Cream Butter	Raw	May 28	June 27	July 11	Aug. 7	Aug. 29	Sept. 29
Golden Fringed	Wilson	May 30	June 27	July 21	Aug. 9	Sept. 4	....
Golden Head (French, pomme d'or)	Vil	May 30	June 28	July 21	Aug. 11	Aug. 29	Oct. 13
Marblehead Cabbage	D. of A	May 28	June 25	July 2	July 30	Aug. 13	Sept. 20
Ohio (French, de l'Ohio)	Vil	May 29	June 28	July 21	Aug. 20	Sept. 4	....
Sibley's American Beauty	Sib	May 28	....	July 21	Aug. 22	Sept. 4	Sept. 29
Thorburn's Market Gardener's	Hal	May 30	June 27	July 14	Aug. 6	Aug. 23	....

DESCRIPTIVE NOTES.

Bloomsdale Early Summer Creole. Closely resembled the Berlin, as described in Report New York Agricultural Experiment Station, 1885, page 141.

Buttercup. A very fine heading variety of medium size, resembling in its general characters the above, but of a beautiful golden yellow color. It was one of the latest to run to seed, and was of superior mildness and tenderness. I regard it as one of the very best summer varieties for the family garden.

California Cream Butter. Plant very vigorous, about 12 inches in diameter and 7 inches tall when fully developed; clear green, with a few scattering brown spots, the outer head leaves very perceptibly tinged with brown; leaves roundish, remarkably thick, obscurely dentate throughout, apex broadly retuse, veins sunken, rather conspicuous, surface slightly blistered; forms a rather poorly defined, compact, roundish head about 4 inches in diameter, the leaves about the head exposing rather conspicuously their lower surfaces.

The quality of this lettuce is of the very best.

Golden Fringed. Closely resembled the Buttercup, but was a little larger and more vigorous. The seed was considerably mixed.

Golden Head. Seemed to be the same as the above.

Marblehead Cabbage. This was quite distinct from, and decidedly inferior to, the Marblehead Mammoth Cabbage from Mr. Gregory, grown in 1886. It appeared to be an inferior strain of the Berlin that soon became bitter and ran to seed early.

Ohio. Very similar to Early Simpson, described in our report for 1885, page 147.

Sibley's American Beauty. Very similar to, if not identical with, Black Seeded Simpson. (Described Ibid, page 141.)

THE MUSKMELON.

Seeds of the muskmelons named below were planted in the Station garden May 24, one drill of each twelve feet long, the drills seven feet apart.

MUSKMELON — A TEST OF VARIETIES.

NAME.	Seeds from	First bloom.	First ripe fruit.
Baltimore Nutmeg	Liv	July 7	Sept. 10
Emerald Gem	Hen	July 9	Sept. 8
Extra Early Hackensack	D. of A	July 7	Sept. 4
Golden Perfection (French, boule d'or)	Vil	July 23	
Grand View	P. and R	July 14	Sept. 8
Honey Dew Green Citron	Wilson	July 9	Sept. 12
Miller's Cream	Va'gh'n	July 10	Sept. 21
Miller's Cream Nutmeg	Greg	July 14	Sept. 21
New Orange Cream	Liv	July 7	Sept. 21
New Vandalia	Bragg	July 7	Sept. 17
Osage	Va'gh'n	July	Sept. 17
Perfection	Liv	July 11	Sept. 14
Princess	Ia. S. Co	July 9	Sept. 10
Queen	Raw	July 9	Sept. 14
Sibley's Best	Sib	July 9	Sept. 8
Spanish Nectar	Wilson	July 9	Sept. 10
Surprise	P. and R	July 9	Sept. 23
Tours' Sugar(French, sucrin de Tours)	Vil	July 9	
Mango Melon	Finch	July 9	Sept. 10

DESCRIPTIVE NOTES.

Baltimore Nutmeg. Plant vigorous and productive; stems running 3 to 5 feet; fruit more or less distinctly oval, but sometimes nearly round, distinctly ribbed, the ribs mostly covered with a dense, whitish network, larger specimens 7 inches long, 5 inches in diameter; flesh green, shading to white at the center, very juicy, sweet and pleasant.

The fruit of this variety indicated considerable mixture of the seed.

Emerald Green. Plant moderately vigorous and productive; stems running about 4 feet; fruit roundish or slightly oval, distinctly ribbed, deep green, with rather sparse whitish network, average samples about 4 inches in diameter in both directions; stem detaches at maturity; flesh orange, thick, rich, sweet and firm, quality superior.

This appeared to be a rather small strain of the Christiana.

Extra Early Hackensack. Plant vigorous and productive; stems running 4 to 5 feet; fruit roundish, distinctly ribbed, strongly netted, yellowish when ripe, well-developed samples 5 to 6 inches in diameter; flesh pale green, very sweet and delicious. The stem does not detach itself at maturity.

One of the best of the early large-sized, green-fleshed varieties.

Golden Perfection. Evidently not adapted to our climate. The vine made a feeble growth and the foliage had an unhealthy appearance. Few fruits set and none matured.

Described and illustrated in Les Plantes Potagères, page 344, and in The Vegetable Garden, page 336.

Grand View. Plant very vigorous and productive; stems running 4 or 5 feet; fruit roundish, distinctly ribbed, largely covered with a whitish network over a rather rich green ground, furrows whitish green, well-developed samples 5 inches in diameter; flesh orange, very rich, sweet and pleasant.

Honey Dew Green Citron. This appeared much mixed. Some of the fruits were very oblong oval and large in size; others were small and approaching round; flesh pale yellow, moderately rich, sweet.

Miller's Cream. Plant vigorous and very productive; stems running 4 to 5 feet; fruit regularly oval, distinctly ribbed, finely netted, greenish brown when ripe; average samples 4 inches in diameter, 5 inches through the axis; flesh very rich yellow or orange, firm, extremely sweet, rich and delicious.

One of the finest melons I have tested. Its chief fault is that it is rather late in ripening.

Miller's Cream Nutmeg was the same as the above.

New Orange Cream. Plant moderately vigorous, productive; stems running about 4 feet; fruit roundish, without ribs, pale yellow when ripe, thickly netted, the network colored like the ground, well developed samples 4 inches in diameter; flesh green, shading to whitish at the center, very sweet, and remarkably high flavored for a green-fleshed melon.

New Vandalia. Plant moderately vigorous, productive; stems running about 4 feet; fruit roundish or oval, distinctly furrowed, somewhat netted, pale yellow when ripe, average samples

5 inches in diameter, 6 inches through the axis; flesh very pale green, rather lacking in sweetness.

Osage. Plant moderately vigorous, productive; stems running 4 to 5 feet; fruit roundish or short oval, distinctly ribbed, larger samples 6 nches in diameter, 7 inches through the axis; flesh orange, rich and sweet, firm.

I consider this a synonym of the Christiana.

Perfection. Plant moderately vigorous, productive; stems running 4 or 5 feet; leaves rather smaller than in most other varieties; fruit roundish, distinctly ribbed, rather deep green, more or less densely netted, furrows yellowish in the fully ripe fruit, average samples 5 inches in diameter; flesh yellow, combining the tenderness and sweetness of the green-fleshed with the richness of the orange-fleshed melons.

A superior variety.

Princess. Plant vigorous, but apparently not very hardy productive; stems running about 4 feet; fruit roundish or slightly oval, distinctly ribbed with a greenish ground which is almost covered with a whitish network, well-developed samples 5 to 6 inches in diameter; flesh orange, firm, sweet and rich.

Queen. Plant vigorous and productive; stems running 4 feet; fruit roundish, or roundish oval, yellowish green when ripe, with rather spare network, ribs very obscure; flesh pale green, shading to whitish at the center, very tender, sweet and pleasant, unexcelled in its class.

Sibley's Best. Plant very vigorous, more productive than most of the others grown; stems running 5 feet; fruit slightly oblate or roundish, distinctly ribbed, pale yellowish green when ripe, more or less covered with network, average samples 5 inches in diameter, 4 inches through the axis; flesh pale orange, tender, rich and sweet.

Spanish Nectar. Plant moderately vigorous, but apparently not able to endure the least cold, as the vines died very early; moderately productive; stems about 4 feet long; fruit oblong, distinctly ribbed, yellowish green when fully ripe, larger samples 6 inches in diameter, 7 inches long; flesh pale yellowish green, quality medium.

Surprise. Plant very vigorous and productive; stems running 4 or 5 feet, much branched; fruit roundish or slightly oblong, distinctly ribbed, pale yellow when ripe, rather densely netted, well-developed samples 5 to 6 inches in diameter; flesh rich orange or salmon, firm, rich, sweet and delicious.

I regard this as one of the best.

Tours Sugar. Plant not vigorous; stems about 3 feet long. The fruits were produced abundantly, but did not mature before frost; in form they were spherical, obscurely ribbed, densely netted, the larger samples about 4½ inches in diameter and had orange flesh.

Described and illustrated in Les Plantes Potagères, page 340, and in The Vegetable Garden, pages 331–2.

Mango Melon. This is not a muskmelon, though it is apparently allied to it. It was the same as the "Vine Peach," of which seeds were received from the Iowa Seed Company and appears to resemble, except in form and color, the Sweet Scented or Queen Anne's Pocket Melon (French, Melon Dudiam), described in Les Plantes Potagères, page 350, and in The Vegetable Garden, page 342. It was tested for mangoes and pronounced superior for this purpose.

THE WATERMELON.

eeds of the following list of watermelons were planted on the same day and in the same manner as the muskmelons. The fruits of the "Chinese" variety did not mature, those of the Apple Pie and Colorado Preserving ripened, but the date could not be definitely ascertained. The others were found to be ripe on the dates noted, though it is probable that some might have been marked ripe at a somewhat earlier date.

WATERMELON — A TEST OF VARIETIES.

NAME.	Seeds from	First bloom.	First ripe fruit.
Apple Pie	Liv	July 16	....
Burpee's Hungarian Honey	Hal	July 14	Sept.
California	Sib	July 17	Sept.
Chinese	Va'gh'n	Aug. 13	....
Colorado Preserving	Wilson	July 20	....
Green and Gold	Hen	July 21	Sept.
Honey	Greg	July 16	Sept. 14
Jones' Jumbo	Va'gh'n	July 16	Sept. 20
Jordon's Gray Monarch	Thor	July 16	Sept. 14
Kolb's Gem	D. of A	July 17	Sept. 20
New Christmas	Bragg	July 17	Sept. 26
Pride of Kansas	Wilson	July 16	Sept. 14
Salzer's Earliest	Beyer	July 10	Sept. 14
Triumph of Asia	Liv	July 16	Sept. 20
Triumph of Asia Improved	Beyer	July 16	Sept. 20

DESCRIPTIVE NOTES.

Apple Pie. Plant extremely vigorous and quite productive, with very large, broad-lobed leaves; stems often running 10 feet fruit spherical, very deep green, with irregular longitudinal stripes and spots of greenish yellow, larger samples 10 inches in diameter. This melon belongs to the citron class.

Burpee's Hungarian Honey. Plant not very vigorous but quite productive; stems about 4 feet long; leaves narrowly lobed; fruit spherical, deep green, sometimes shading to rather pale green in places, larger samples 6 inches in diameter; flesh pale red, very thick, juicy, sweet and well flavored; seeds light brown, oblong, rather thick, about ⅜ of an inch long.

California. Plant moderately vigorous, quite productive; stems about 4 feet long; fruit spherical, very deep dull green, scarcely mottled or penciled, with a slight bloom, larger samples 6 inches in diameter; flesh pale red, very sweet, juicy and pleasant; seeds chocolate-brown, mottled with yellowish, oblong, ½ inch long.

Chinese. This plant is not a watermelon, but the Wax Gourd, *Benincasa cerifera Savi*; described and illustrated in Les Plantes

Potagères, page 34, and in The Vegetable Garden, page 271. The fruits did not fully ripen.

Colorado Preserving. Quite similar to the "Apple Pie" watermelon or citron. The plant was somewhat less vigorous, the leaves rather narrower and the fruit a little smaller, which was the chief difference.

Green and Gold. Plant vigorous and productive; stems 4 to 5 feet long; leaves rather broadly lobed; fruit spherical, deep green, penciled with blackish green and mottled with yellowish spots, larger samples 7 inches in diameter; flesh lemon yellow thick, juicy and pleasant, but lacking in richness; seeds light brown, with a chocolate-colored mark about the suture, fully ½ inch long.

Honey. Plant moderately vigorous, very productive; stems 2 to 4 feet long; fruit spherical, shaded with irregular narrow stripes of deep green, and yellowish green, the whole surface rather finely penciled with the two shades, well-developed samples about 5½ inches in diameter; flesh creamy white, flavor very mild, delicate and pleasant; seeds light brown, mottled with chocolate-brown, almost black at the apex, usually rather thick.

Jones' Jumbo. Plant vigorous, but not productive; stems 3 to 5 feet long; fruits roundish, very dark green, more or less penciled or mottled with lighter green, often obscurely striped; well-developed samples 6 inches in diameter; flesh pale red, very sweet and high flavored; seeds white, with a yellowish spot on each flat side, rather short and broad, about ½ inch long.

Jordon's Gray Monarch. Plant vigorous, very productive; stems about 4 feet long; fruit short oval or roundish, greenish white, finely penciled and mottled with clear green; well-developed samples 6 inches in diameter, 7 inches long; flesh pale red, crisp, sweet and pleasant; seeds white, about ½ inch long.

Kolb's Gem. Plant moderately vigorous, productive; fruit roundish or very slightly oblong, the ends a little depressed, covered with irregular dark green stripes over a whitish ground, the latter mottled with pale green, the dark green and whitish stripes about equal in width; flesh rose, sweet and pleasant; seeds black, more or less bordered with white.

New Christmas. Plant very vigorous and productive; stems 5 to 7 feet long; leaves large with rather broad lobes; fruit short oval or roundish, deep green, penciled and mottled with yellowish green, obscurely striped; well-developed samples 7 to 8 inches in diameter; flesh pale red, very sweet and pleasant; seeds small, pure white.

Pride of Kansas. Plant rather feeble, but very productive for its size; stems 3 to 4 feet long; fruit roundish or slightly oval, very deep dull green, scarcely penciled, with a rather thick bloom; well-developed samples 7 inches in diameter; flesh pale red, very sweet and pleasant; seeds finely mottled with chocolate and light brown, about ½ inch long.

Salzer's Earliest. Plant healthy and hardy but not a strong grower, productive; stems 3 feet long; fruits roundish or oval, color rather variable, in some specimens very deep mottled green, in others rather pale green penciled with darker, well-developed samples 7 inches in diameter; flesh pale red, very sweet and pleasant; seeds very dark chocolate-brown, approaching black, about ½ inch long.

Triumph of Asia. Plant moderately vigorous, productive; stems 3 to 5 feet long; fruit roundish or slightly oval, very dark mottled green, without stripes, well-developed samples 7½ inches in diameter; flesh rich red, very sweet and pleasant; seeds small, black.

Triumph of Asia Improved. Too much mixed for description.

OKRA.

Seeds of the following named okras were planted in the garden May 24, one row of each twelve feet long, the rows three and one-half feet apart. As appears from the table a part at least of the pods matured on all, and all were fit for use before the middle of August. The plants of okra are rather difficult to start in the hot-bed or cold-frame, owing to their liability to damping off. Planted in the open ground, however, they are grown without difficulty.

OKRA — A TEST OF VARIETIES.

NAME.	Seeds from.	First bloom.	Fit for table use.	First ripe seed.	
Improved Dwarf Green	Ia. S. Co.	July 23	July 30	Sept. 20	Plants not uniform, some tall, others short.
Little Gem	Dreer	July 23	July 28	Before Sept. 20	Very dwarf, plants very uniform.
New Dwarf Density	Thor	July 25	Aug. 1	Before Sept. 20	Very dwarf, plants very uniform.
Velvet	Dreer	July 25	Aug. 6	Oct. 13	Plants not uniform in height.
White Velvet	Hen	July 25	Aug. 6	Oct. 13	Plants not uniform in height.

THE PEA.

The peas named in the following table were planted in the Station garden April 25, one drill twelve feet long of each, the drills three and one-half feet apart. The seeds were placed about three inches apart and covered one inch deep. All of the taller-growing sorts were bushed :

PEA — A TEST OF VARIETIES.

NAME.	Seeds from	First bloom.	Fit for table use.	First ripe seed.	Last ripe seed	No. of pods per hundred plants.	No. of peas per hundred pods.	Total yield (dry) per hundred plants.
Wrinkled sorts in *italics*.								Ounces.
American Champion	Hen.	June 16	June 29	July 15	Aug. 8	870	433	42.8
Blue Beauty	Hen.	June 11	June 21	July 6	July 14	710	334	29.8
Blue Wrinkled	S. & N. S. Co.	June 18	July 5	July 18	Aug. 15	1,558	411	58.8
Dwarf Champion of England	Greg	June 8	June 30	July 17	Aug. —	843	318	44.4
Dwarf Maincrop	S. & N. S. Co.	June 18	July 2	July 17	Aug. 8	1,045	348	36.0
Edinburgh Beauty	Cleve	June 13	June 28	July 14	Aug. 7	1,261	347	41.0
Hampden Earliest	Bragg	June 6	June 21	July 5	July 18	849	556	34.7
Henderson's Midsummer	Hen	June 16	July 2	July 14	July 28	942	382	41.5
Late	S. & N. S. Co.	June 15	July 5	July 17	Aug. 1	633	622	68.7
Laxton's Charmer	Hen.	June 13	June 29	July 11	Aug. 8	1,151	476	54.0
Laxton's Evolution	Va'gh'n	June 18	July 5	July 21	Aug. —	1,126	598	45.0
Long Island Mammoth	Cleve	June 15	June 29	July 11	Aug. 8	775	486	42.0
Maincrop	S. & N. S. Co.	June 18	June 29	July 11	Aug. —	1,640	329	69.0
Maud S	D. of A.	June 6	June 19	June 29	July 11	495	419	17.0
McLean's Little Gem	Thor.	June 11	June 21	July 9	July 17	686	395	22.7
Medium Maincrop	S. & N. S. Co.	June 15	June 29	July 11	Aug. 17	1,778	404	83.0
Payne's Conqueror	Hen.	June 18	July 8	July 18	Aug. 9	1,769	348	84.0
Sander's Marrow	Hen.	June 24	July 10	July 26	Aug. 16	1,610	335	73.7

Second Early	**S. & N. S. Co.**	**June 18**	**June 29**	**July 14**	**Aug. 8**	1,216	637	73.5
Sharp's Paragon	Cleve	June 18	June 28	July 14	Aug. 8	917	506	63.2
Sharp's Invincible	Cleve	June 18	July 3	July 18	Aug. 8	1,252	494	76.0
Sharp's Triumph	Cleve	June 18	June 29	July 17	Aug. 8	820	582	54.7
Station	Sta	June 6	**June 19**	July 3	July 14	730	469	
Yorkshire Gem	Hen	June 18	July 5	July 20	Aug. 16	1,288	453	75.7

As appears, the "Station," a wrinkled sort developed at this Station, proved earliest; the medium main crop from the English Specialty and Novelty Seed Company yielded the largest number of pods per plant; the "Late," from the same source, the largest number of peas to the pod, and Payne's Conqueror, from Henderson, the largest yield of dry peas.

DESCRIPTIVE NOTES.

American Champion. Height 3 to 3½ feet; foliage rather pale, stipules rather large, much washed with white; stem large, angular, little branched, nodes about 3 inches apart; peduncles rarely more than 2 inches long; pods not very numerous, often in pairs, colored like the foliage, usually more or less recurved, narrowing gradually to the apex, 3 to 4 inches long, ¾ to ⅞ inch wide, and becoming ribbed as they approach maturity; peas 6 to 8 in a pod; when ripe very large, strongly wrinkled, green and white.

Blue Beauty. Height 20 to 24 inches; foliage rather pale, leaflets closely set, the upper ones a little waved, stipules washed with white; stems strong, nodes rarely more than 2 inches apart; peduncles slender, often 3 inches or more long; pods very numerous, usually in pairs, paler than the foliage, straight, plump, blunt at the apex, 2½ to 3 inches long, ½ inch wide; peas 5 to 6 in a pod, closely set, squared; when ripe small, smooth, green or spotted with white.

Blue Wrinkled. Height 3 to 4 feet; foliage compact, deep green, glaucous, leaflets rarely more than 4, much waved, stipules large, waved, washed with white; stem branched, nodes rarely more than 2 inches apart; peduncles generally short, rather large; pods not very numerous, often in pairs, moderately well filled, colored like the foliage, straight, very plump and blunt at the apex, 3 to 3½ inches long, ¾ of an inch wide; peas 5 to 7 in a pod, much compressed, ½ inch in longest diameter; when ripe of medium size, much wrinkled, green and white.

Dwarf Champion of England. Height 2 feet; foliage deep green, stipules much washed with white; stem strong, with very short internodes; peduncles remarkably short, rarely more than an inch long; pods very numerous, borne rather high on the stems, distinctly paler than the foliage, usually in pairs, straight, very plump, 1½ to 3 inches long, ⅝ inch wide, not always well filled, a little depressed between the peas, apex not on a line with the back of the pod; peas 3 to 6 in a pod, very large, much compressed; when ripe, much flattened and wrinkled, mostly white.

A productive variety, but the pods are rather small for market.

Dwarf Maincrop. Height 20 inches; foliage deep green, a little waved, especially toward the top of the plant, stipules large, much washed with white; stem very strong with very short internodes; peduncles rarely more than an inch long, strong, often recurving; pods numerous, often in pairs, a little paler than the foliage, straight or slightly recurved, 3 to 4 inches long, ⅝ inch wide, ribbed a little as they approach maturity; peas 5 to 7 in a pod, oblong, flattened, large; when ripe smooth, green and white.

Edinburgh Beauty. Height 1½ feet; foliage deep green, leaflets usually small, stipules small, glaucous, washed with white; stem strong, nodes rarely more than 2 inches apart; peduncles rather slender, straight, sometimes 3 inches long; pods numerous, usually in pairs, paler than the foliage, straight, depressed between the peas, 1½ to 3 inches long, ½ to ⅝ inch wide, apex blunt; peas 3 to 6 in pod, much compressed; when ripe of medium size, much flattened and wrinkled, mostly white.

Hampden Earliest. Apparently a strain of Philadelphia. For description of the latter see Report New York Agricultural Experiment Station, 1884, page 248.

Henderson's Midsummer. Height 3 feet; foliage deep green, stipules somewhat washed with white; stem strong, angular, nodes rarely more than 2 inches apart; peduncles usually a little recurved, rarely more than 2½ inches long; pods borne in the greatest abundance and rather high on the stems, almost always in pairs, decidedly paler than the foliage, usually slightly recurved, 2 to 3 inches long, ⅝ of an inch wide, blunt when fully developed; peas 4 to 6 in a pod, slightly flattened, compressed, large; when ripe of medium size, much flattened and wrinkled, white.

An excellent late variety.

"*Late*" (from English Specialty and Novelty Seed Company). Height 3 to 3½ feet; foliage very deep green, slightly glaucous, a little waved; stipules little washed with white; stem straight, with short internodes, much branched above; pods not numerous, single, same color as the foliage, distinctly recurved, narrow, 3 to 4 inches long, $\frac{5}{8}$ inch wide; peas 5 to 10 in a pod, much compressed, large; when ripe rather small, wrinkled, mostly green.

Not sufficiently productive to be valuable.

Laxton's Charmer. Height 4 to 4½ feet; foliage deep green, rather sparse, leaflets small, sharp-pointed, stipules small; stem slender, branched above, nodes often 4 inches apart; peduncles usually long, slender, straight; pods numerous, very often in pairs, same color as the foliage, strongly recurved, narrow, much ribbed as they approach maturity, 3 to 3½ inches long, ½ of an inch wide; peas 5 to 10 in a pod, much flattened by compression; when ripe of medium size, wrinkled, mostly white.

A very promising variety.

Laxton's Evolution. Height 3 feet; foliage deep green, strongly waved, leaflets broad, stipules roundish, large, little washed with white; stem very strong, much branched above, nodes rarely more than 2 inches apart; peduncles strong, usually short and recurved; pods numerous, often in pairs, same color as the foliage, strongly recurved, especially toward apex; peas 6 to 10 in a pod, much compressed, large; when ripe of medium size, moderately wrinkled, largely dark green.

A promising late variety.

Long Island Mammoth. Height 3½ to 4 feet; foliage pale green, stipules large, strongly washed with white; stem remarkably large, nodes 3 inches or more apart; peduncles strong, usually recurving, about 2 inches long; pods numerous, borne high, very often in pairs, same color as foliage, recurved, very plump, 3½ to 4 inches long; peas 6 to 8 in a pod, oval, little compressed; when ripe large, scarcely wrinkled, green and white.

Maincrop. Height 4 to 5 feet; plants not spreading; foliage medium in shade, stipules little washed with white; stem strong, nodes often 4 inches apart; peduncles slender, recurved, often 3 inches long; pods numerous, borne high, very often in pairs, scarcely paler than the foliage, a little recurved, 2½ to 3 inches long, $\frac{5}{8}$ of an inch wide; peas 4 to 6 in a pod, large, flattened, little compressed; when ripe much flattened and wrinkled, green and white.

Maud S. A strain of Philadelphia.

McLean's Little Gem. Described in Report New York Agricultural Experiment Station, 1884, page 269.

Medium Maincrop. Height 3½ to 4 feet; foliage deep green, stipules large, a little washed with white; stem slender, little branched, nodes sometimes 4 inches apart; pods numerous, borne very high, same color as the foliage, straight or slightly recurved, 3 to 3½ inches long, ⅝ of an inch wide; peas 6 to 9 in a pod, slightly compressed; when ripe large, flattened and wrinkled, green and white.

Payne's Conqueror. Height 5 feet; foliage rather pale, somewhat glaucous; stipules little washed with white; nodes of stem sometimes 4 inches apart; peduncles recurving, rarely more than 2 inches long; pods numerous, borne very high, very often in pairs, scarcely paler than the foliage, straight, 3 to 3½ inches long, ⅝ inch wide; peas 4 to 6 in a pod, large; when ripe very large, much flattened and wrinkled, green and white.

A very productive variety, but too tall and late to be of much value here.

Sanders' Marrow. Height 4 to 4½ feet; foliage deep green, very glaucous, considerably waved; stipules much washed with white toward base; stem much branched above, nodes often 3 inches apart; peduncles generally recurving, rarely more than 2 inches long; pods rather numerous, borne high, usually in pairs, paler than the foliage, straight, 3 to 3½ inches long, ⅝ inch wide, not well filled; peas 3 to 6 in a pod, large; when ripe very large, much flattened and wrinkled, green and white.

A good late variety.

"*Second Early*" (from English Specialty and Novelty Seed Company). Height 2 feet; foliage deep green, considerably waved toward the top, stipules large, very glaucous, washed with white; stem strong, nodes rarely more than 2½ inches apart; peduncles strong, very short; pods numerous, generally in pairs, paler than the foliage, rather distinctly recurved, 3 to 3½ inches long, ⅝ inch wide; peas 6 to 8 in a pod, large, oblong; when ripe of medium size, much wrinkled, green and white.

Sharp's Paragon. Height 4 feet; foliage rather pale, stipules very glaucous, strongly washed with white; nodes rarely more than 3 inches apart; peduncles usually less than 2 inches long; pods not numerous, borne high, a little paler than the foliage, straight or slightly recurved, 3½ to 4 inches long, ¾ inch wide; peas 6 to 8 in a pod, oval, not compressed, when ripe large, wrinkled, green and white.

Not sufficiently productive to be valuable.

Sharp's Invincible. Height 3 feet; foliage rather pale, stipules scarcely washed with white; stem strong, nodes very close, rarely 2 inches apart; peduncles rarely more than 2 inches long; pods very numerous, very often in pairs, same color as foliage, rather distinctly recurved, 3 to 3½ inches long, ⅝ inch wide; peas 6 to 8 in a pod, somewhat compressed, rather large; when ripe of medium size, scarcely wrinkled, mostly green.

A promising variety.

Sharp's Triumph. Height 2 feet; foliage deep green, a little glaucous, waved toward the top, stipules a little washed with white; stem very strong, nodes close, rarely 2 inches apart; peduncles very short, rather strong; pods very numerous, often in pairs, a shade paler than the foliage, more or less recurved, 3½ to 4 inches long, ⅝ to ¾ inch wide; peas 6 to 9 in a pod, large, little compressed; when ripe large, flattened, moderately wrinkled, green and white.

Station. Habit very much like that of Philadelphia; pods not very numerous, often in pairs, straight, paler than the foliage; peas medium in size, compressed when full grown; when ripe medium to small, much wrinkled, green and white.

Yorkshire Gem. Height 2½ feet; foliage deep green, glaucous, strongly waved, stipules not washed with white; stem strong, nodes very close, rarely 2 inches apart; peduncles usually short and recurved; pods very numerous, usually in pairs, a shade paler than the foliage, straight, 3 to 4 inches long, ⅝ of an inch wide; peas 6 to 8 in a pod, large, compressed; when ripe very large, much flattened and wrinkled, green and white.

A promising late variety.

THE TOMATO.

Seeds of the tomatoes named below were planted in boxes in the hot-bed March 23, and eight plants of each transplanted to the garden May 2. The plants were set three feet apart in rows seven feet apart. The following data were noted:

TOMATO—A TEST OF VARIETIES.

NAME.	Seeds from	First bloom.	First ripe fruit.
Amber Gem	Sib	June 18	Aug. 25
Bay State	Bragg	June 18	Aug. 7
Dwarf Champion	Hen	June 18	Aug 3
Eley's King of the Earlies	Eley	June 18	Aug. 4
Ignotum	Bailey	June 15	July 30
Morning Star	Beyer	June 18	Aug. 29
Prize Belle	Thor	June 18	Before Aug. 25
Scoville's Hybrid	Va'gh'n	June 16	Before Aug. 25
Volunteer	Va'gh'n	June 16	Aug. 6

DESCRIPTIVE NOTES.

Dwarf Champion. Plant vigorous, dwarf in habit, branches reclining on the ground; foliage deep green, with broad, very thick, much blistered, waved, coarsely-toothed leaves; fruits numerous, rich purplish red, oblate, very regular and entirely smooth, average samples about 3 inches in diameter, 2 inches through the axis; cells 4 or 5; flesh very firm, tender at the center, flavor mild and pleasant.

I regard this as a distinct and valuable new variety which seems worthy of general introduction.

Eley's King of the Earlies. Plant rather dwarf, spreading; leaflets rather narrow, somewhat rolled; fruits scarlet, exceedingly numerous, but often quite irregular and corrugated, oblate, 2 to 3 inches in diameter, cells 6 to many; flesh soft and inferior in quality.

Ignotum. The fruit of this variety was somewhat variable, particularly in size. Some plants bore fruit perfect in form, of large size and of the finest quality; others bore smaller and less desirable fruit.

Morning Star. Closely resembles Mikado, described in our report for 1887, page 300. The leaves may be a little smaller, but no other difference appeared.

New Bay State. This appeared identical with the Livingston's Favorite, grown in previous years and described in our report for 1887, page 293.

Prize Belle. Not distinguishable from the above.

Scoville's Hybrid. Resembled the above, but the fruit was quite variable and the variety is evidently not fixed.

Sibley's New Amber Gem. Doubtfully distinct from the Golden Queen grown in 1887, seed from Thorburn, described in report for 1887, page 297.

Volunteer. Doubtfully distinct from the Livingston's Favorite. The fruits may be slightly thicker, but I am not certain of this. In quality it is unsurpassed.

THE STATION ARBORETUM.

A portion of the farm bordering the brook on each side, either lies too low, or is too undulating to be available for profitable cultivation. As the soil of this area is well adapted to the growth of trees and lies convenient both to the highway and to the Station buildings, it was thought that possibly the wisest purpose to which it could be devoted would be to plant it out with a collection of species and varieties of ornamental and forest trees. The area includes about seventeen acres, and while this is insufficient for an extensive collection, it will nevertheless afford room for one specimen each of nearly all the species and varieties now grown in this country. Through the generous assistance of several nurserymen of Geneva* 123 specimens were planted out the past season, all of which were donated to the Station, and it is proposed to extend the list, as means permit, until the ground is all occupied, allowing of course sufficient room for the full development of each specimen and for convenient walks and drives. It is hoped that in the course of a few years this area will form one of the most attractive and instructive features of the Station farm.

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* The Station acknowledges its indebtedness to Messrs. Selover & Atwood, R. G. Chase & Co., W. & T. Smith, T. C. Maxwell & Brothers, Bronson & Hopkins, Sears, Henry & Co. and Merrell, Anthony & Co. for assistance in starting our arboretum. But for the aid kindly furnished us by these gentlemen it would have been necessary to postpone the work for at least a year.

The following list includes the trees planted out to date. For the nomenclature I have had to depend largely upon nursery catalogues, though the catalogue names have been compared with, and so far as possible verified by the names employed in the Illustrated Dictionary of Gardening and Dr. Gray's Field, Forest and Garden Botany.

DECIDUOUS TREES.

Acer campestre — English or cork-barked maple.
——— *Colchicum rubrum* or *luteum* — Red Colchicum maple.
——— *dasycarpum* — White or silver-leaved maple.
——— ——— *Wierii laciniatum* — Weir's cut-leaved silver maple.
——— *Pennsylvanicum* — Striped-barked maple.
——— *platanoides* — Norway maple.
——— ——— *Rietenbachi* — Rietenbach's Norway maple.
——— *Pseudo Platanus* — Sycamore maple.
——— ——— *purpureum* — Purple-leaved sycamore maple.
——— *saccharinum* — Sugar or rock maple.
Æsculus flava — Yellow horse-chestnut.
——— *Hippocastanum* — Common horse-chestnut.
——— ——— *alba flore pleno* — Double white-flowered horse-chestnut.
——— ——— *rubicunda* — Red-flowering horse-chestnut.
——— *Pavia* ? — Dwarf horse-chestnut.
Alnus glutinosa — European alder.
——— ——— *laciniata* — Cut-leaved alder.
——— ——— *laciniata imperialis* — Imperial cut-leaved alder.
Betula alba — European white birch.
——— ——— *laciniata* — Cut-leaved birch.
——— ——— *pendula laciniata* — Cut-leaved weeping birch.
——— ——— *pendula elegans.*
——— ——— *purpurea* — Purple-leaved birch.
Catalpa bignonioides.
——— ——— *speciosa.*
——— *Kœmpferi.*
——— *Teas' Japanese hybrid.*
Cerasus avium flore alba plena — Large double-flowering cherry.

Cerasus pumila pendula — Dwarf weeping cherry.
Cersis Canadensis — American Judas tree.
——— *Japonica* — Japan Judas tree.
Cratægus Oxycantha — English hawthorn.
——— ——— *coccinea flore pleno* — Double scarlet thorn.
——— ——— *flore pleno Paulii* — Paul's double scarlet thorn.
Fagus sylvatica — European beech.
——— ——— *heterophylla* — Fern-leaved beech.
——— ——— *pendula* — Weeping beech.
——— ——— *purpurea* — Purple-leaved beech.
——— ——— *laciniata* — Cut-leaved beech.
Fraxinus Americana — White ash.
——— *excelsior* — European ash.
——— ——— *aurea* — Golden-barked ash.
——— ——— *aurea pendula* — Golden-barked weeping ash.
——— ——— *myrtifolia* — Myrtle-leaved ash.
——— ——— *pendula* — Weeping ash.
——— ——— *variegata* — Variegated-leaved ash.
——— *oxyphylla parvifolia* — Lentiscus-leaved ash.
Gymnocladus Canadensis — Kentucky coffee tree.
Laburnum vulgare — English laburnum.
——— *Alpina* — Scotch laburnum.
Larix Europœa — European larch.
Liquidamber stryaciflua — Sweet gum or liquid amber tree.
Liriodendron tulipifera — Tulip tree.
Magnolia acuminata — Cucumber magnolia.
——— *Lennei* — Lenne's magnolia.
——— *purpurea* — Purple magnolia.
——— *Soulangeana* — Soulange's magnolia.
——— *speciosa* — Showy-flowered magnolia.
——— *Umbrella* — Umbrella magnolia.
Also two Chinese sorts, unnamed.
Negundo aceroides — Ash-leaved maple or box-elder.
Persica vulgaris flore rosea plena — Double-flowering red peach.
Populus alba — Silver-leaved poplar.
——— ——— *Bolleana.*
——— *balsamifera* — Balsam poplar.
——— *Carolina* — Green-leaved, or Carolina poplar.
——— *dilitata* — Lombardy poplar.

Populus grandidentata pendula — Weeping tooth-leaved poplar.
——— *monilifera aurea Van Geertii.*
Prunus sinensis flore pleno ?— Chinese double-flowering cherry.
Pyrus Americana nana — Dwarf mountain ash.
——— *aucuparia* — European mountain ash.
——— ——— *pendula* — Weeping mountain ash.
——— ——— *quercifolia* — Oak-leaved mountain ash.
——— *hybrida* — Hybrid mountain ash.
——— *malus pendula* — "Elise Rathke," new German weeping apple.
——— *spectabilis flore alba pleno* — Chinese double white-flowering crab.
——— ——— *flore rosea pleno* — Chinese double rose-flowering crab.
Quercus alba — White swamp oak.
——— *coccinea* — Scarlet oak.
——— *macrocarpa* — Burr or mossy-cup oak.
——— *Robur* — English oak.
——— ——— *pedunculata concordia* — Golden oak.
Salisburia adiantifolia — Ginkgo tree.
Salix Babylonica — Babylonian or weeping willow.
——— *Caprea pendula* — Kilmarnock weeping willow.
——— *phylicifolia* ?—Red-twig willow.
——— *purpurea pendula* — New American willow.
——— *rosmarinifolia* — Rosemary willow.
——— *viminalis* — Osier willow.
——— Comewell willow.
Tilia Americana — American linden or basswood.
——— *Europœa* — European linden.
——— ——— *alba* — Silver-leaved linden.
——— ——— *laciniata* — Fern-leaved linden.
——— ——— *rubra* — Red-twigged European linden.
Ulmus Americana — American white or weeping elm.
——— *campestris* — English elm.
——— ——— *stricta purpurea* — Purple-leaved English elm.
Ulmus Dovœi.
——— *Montana* — Scotch or wych elm.
——— ——— *Camperdown pendula*—Camperdown weeping elm.
——— *suberosa* — English cork-barked elm.

Evergreen Trees.

Abies balsamea — Common balsam.
——— *Canadensis* — Hemlock spruce.
——— *excelsa* — Norway spruce.
Cupressus Lawsoniana — Lawson's cypress.
Juniperus Virginiana — Red cedar or savin.
Pinus Austriaca — Austrian pine.
——— *Strobus* — White pine.
——— *sylvestris* — Scotch pine.
Taxus baccata — English yew.
——— ——— *elegantissima* — Beautiful variegated yew.
——— ——— *erecta* — Erect yew.
Thuja occidentalis — American arbor vitæ.
——— ——— *compacta* — Parson's arbor vitæ.
——— ——— *ericoides* — Heath-leaved American arbor vitæ.
——— ——— *Hoveyi* — Hovey's golden arbor vitæ.
——— ——— *globosa* — Globe-headed arbor vitæ.
——— ——— *pyramidalis* — Pyramidal arbor vitæ.
——— ——— *Siberica* — Siberian arbor vitæ.
——— *orientalis Tartarica* — Tartarian arbor vitæ.

EXPERIMENTS WITH INSECTICIDES.

Applications for the codling moth.
Potassium sulphide for insects.
Applications for the cabbage maggot.
Experiments with kerosene.
The bean plant as a repellant for the striped cucumber beetle.
The turnip flea-beetle.
A trial of hose nozzles.
An experiment with home-grown pyrethrum.
Summary.

Applications for the Codling Moth.

Three arsenical poisons were tested for the codling moth, *Carpocapsa pomonella* (Linn), viz.: Paris green, London purple and the "Zoektein poison."[*] The last named is a waste product sent to the Station for trial by the "Zoektein Company," of

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[*] The "Zoektein poison" was also tested in 1887, for details of which see Report New York Agricultural Experiment Station for 1887, pp. 98–99.

Albany, N. Y. It appeared to consist largely of arsenic and was soluble in water to about the same extent as the common white arsenic of commerce.

The experiment was made on ten large trees* of the Fall Pippin apple, the sprayings being made upon one-half of each tree, the other half being left unsprayed as a check. Four of the trees were sprayed with Paris green in water at the rate of an ounce to ten gallons, three with London purple at the same rate and three with the "Zoektein poison" at the rate of an ounce to twenty gallons. The first spraying was made June 5, at which time the young fruits were about the size of huckleberries. Other sprayings were made June 16, June 27 and July 2.

September 21 to 24 the wind-falls under the sprayed and unsprayed portions of the trees, with a few of the picked fruits, were examined for injuries from the codling moth. It appeared that the picked fruits contained very few larvæ except those of the second brood of moths, for which the eggs had probably been deposited too late to be much affected by the sprayings. The examination was, therefore, confined chiefly to the wind-falls. The results secured were as follows:

		Number of fruits examined.	Per cent infested.
Treated with Paris green	Sprayed part	347	13.26
	Unsprayed part	355	52.68
Per cent in favor of sprayed part		....	39.42
Treated with London purple	Sprayed part	493	23.53
	Unsprayed part	413	29.30
Per cent in favor of sprayed part		....	5.77
Treated with "Zoektein poison"	Sprayed part	294	9.22
	Unsprayed part	112	38.39
Per cent in favor of sprayed part		....	29.17

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* The trees treated were the same ones as were treated for the apple scab, as described in the article on "Experiments with Fungicides," the poisons being added to the same water, and the two substances applied at the same time. The Paris green was applied with soda hyposulphite, the London purple with potassium sulphide and the "Zoektein poison" with calcium sulphide.

It appears that in this trial the Paris green was most effectual, and the "Zoektein poison" next. The foliage of the trees treated with the latter blackened somewhat after the spraying, probably due to the dissolved arsenic. A similar effect was observed last season when the solution was applied at double the concentration. It would have to be diluted still more before it may be safely used.

The wide variation in the percentage of infested fruits in the unsprayed parts of different trees suggests that the more common method of using check trees for comparison with treated trees may be quite unreliable.

The trees used were considered the best ones available for the experiment. Unfortunately they did not yield a good crop of fruit. The numbers presented are too small to make the experiment conclusive, but the results have a value as furnishing additional data upon this important subject.

POTASSIUM SULPHIDE FOR INSECTS.

For the Currant Worm.

As noted in the article on "Experiments with Fungicides," in this report, potassium sulphide when used as an application for the gooseberry mildew appeared to materially diminish the injury wrought by the currant worm, *Nematus ventricosus* Klug. The moment the spraying commenced upon a bush, all the worms feeding upon it dropped to the ground as if paralyzed. The solution did not, however, appear to be fatal to them, as they soon recovered their activity and disappeared. The sequel showed that they did not return to the sprayed bushes to any great extent. At least these seemed to suffer no injury from the worms, while the unsprayed rows adjoining were nearly defoliated by them, although these rows, in common with the sprayed ones, had received at least two applications of an arsenical poison.

For the Codling Moth.

The observation noted above with reference to the currant worm suggested the question if the potassium sulphide had not also proved beneficial in repelling the codling moth on the trees upon which it was used as a preventive of apple scab. A careful examination was therefore made in the case of the crab apple tree mentioned in the article on "Experiments with Fungicides," with reference to the relative injury from the moth on the sprayed and unsprayed parts. The results were purely negative. More fruits were found to be infested on the sprayed portion of the tree than on the other.

For the Cabbage Maggot.

At the suggestion of State Entomologist Lintner, potassium sulphide was tested for the cabbage maggot, larva of *Anthomyia Brassicæ* (Bouche). An ounce of it was dissolved in a gallon of water at a temperature of about 100° F., and, when cold, two teaspoonfuls of the solution were poured about the stem of each plant. The first application was made May 5, which was before the plants had manifested any injury from the maggot. At this strength the plants appeared to suffer somewhat, hence the later applications, made May 21 and June 5, were reduced to one-fourth of an ounce to the gallon, and about a gill of the liquid was poured about each plant. On June 6 examination showed that the plants were suffering from many live maggots, and there were no indications that the treatment has caused any diminution in the number.

We may conclude, therefore, that while potassium sulphide may have no value as a preventive of injury from the codling moth or cabbage maggot, its value as a fungicide for the gooseberry mildew is enhanced by the fact that it acts as a more or less complete repellant for the currant worm.

OTHER APPLICATIONS FOR THE CABBAGE MAGGOT.

Besides the test for the cabbage maggot noted in the preceding paragraph, trials were made with common salt in solution at the rate of four ounces to the gallon, McDougall's sheep dip diluted with five parts of water, the "Zoektein poison" at the rate of an ounce to five gallons and kerosene used in its pure state. The results were negative so far as their practical value is concerned. The first produced no visible effect, the second apparently failed to injure the insects, but was fatal to the plants, while the third and fourth were fatal to both.

EXPERIMENTS WITH KEROSENE.

In Its Pure State.

Strange to say, kerosene in its pure state appears entirely harmless to certain plants, while it is fatal to others. I was surprised to learn that florists sometimes use it for ridding the coleus from the mealy bug, *Dactylopius adonidum* Linn., and Mr. Hunn has tested it for this purpose in the Station green-house with very satisfactory results. Although the coleus does not appear to be particularly hardy, a plant of the Verschaffeltii variety was sprayed with pure kerosene to such an extent that the foliage and stem were thoroughly covered with the liquid without any injurious effect ensuing. This suggested a series of trials with pure kerosene for insects on out-of-door plants. Accordingly, on June 6, tests were made with it upon the foliage of the rose, grape, peach, currant, gooseberry, potato, tomato and pea, and the applications were repeated once a week on most of these plants for several consecutive weeks. The oil was in every case sprayed upon the plants with the atomizing bellows. The potato and tomato foliage were quite unable to endure a single application; that of the gooseberry shriveled slightly under a copious spraying, but that of the rose, grape, peach and pea endured repeated sprayings without apparent injurious effect. The kerosene proved a most effectual destroyer for the rose-leaf hopper, *Tettigonia rosæ* Harris, that so often infests the leaves of roses.

It must not be understood, however, that the use of pure kerosene is here recommended for general use as an insecticide upon any plants. The facts are given merely as suggestions which may lead to valuable results through further and more elaborate experiments conducted hereafter.

Kerosene Atomized with Water.

The success that has been so largely claimed for the kerosene emulsion suggested the question if kerosene might not be so atomized with water by means of special apparatus that the dilution accomplished by the emulsion would be practically attained. The water and oil added with the emulsion probably evaporate from the foilage soon after the application, leaving only the soap. It would appear entirely possible then, that if the water could be as intimately commingled with the oil during the process of application as is accomplished in the emulsion, the same end would be attained without the annoyances incident to forming and applying the emulsion, which are by no means inconsiderable.

Experiments in this direction were carried far enough to show that there are no mechanical difficulties in the way of atomizing kerosene and water at the same operation. To the Woodason atomizing bellows a small cup was attached directly in front of the fount for holding the liquid to be atomized. From this cup a very slender copper tube was passed through the side of the fount where it entered the larger tube that conducts the liquid from the fount to the mouth of the bellows. It then curved upward, passing through the center of this tube as far as the mouth of the bellows, where both came to an end at the same point. Kerosene was then placed in the added cup and water in the fount. On working the bellows the liquids are atomized together. The proportion of kerosene emitted will depend upon the relative diameters of the two tubes, but it may also be regulated by the relative depths of the liquid in their respective founts.

A better way would be to use but a single fount and to divide this into two parts, one for kerosene and the other for water. This would permit the mouth of the bellows to be brought nearer to the plant to be atomized.

This apparatus was used on many plants in the green-house for the mealy bug and scale insect with excellent success. It was also used for the aphis on the apple and for the leaf-hopper on the rose. For these it was effective so far as the insects were within reach, though in one case when used on the apple tree the foliage was somewhat injured. In a single test for the potato beetle it did not kill all of the insects. The susceptibility of the potato plant to injury from kerosene renders this method of treatment for the potato beetle of very doubtful value.

THE BEAN PLANT AS A REPELLANT FOR THE STRIPED CUCUMBER BEETLE.

Early in the present year an item was circulated in the agricultural press to the effect that common garden beans planted with the seeds of melons and other cucurbits had in certain cases proved a very simple and effective means for repelling the striped cucumber beetle *Diabrotica vittata* (Fabr.). The experiment was tried on quite an extensive scale, but the results showed the expedient to be at best of doubtful value. The attacks of the cucumber beetle were not serious at this Station the past season, but many of the insects were found in immediate proximity to the bean plants.

THE TURNIP FLEA-BEETLE.

For a note in relation to a method of protecting the cabbage plants from the turnip flea-beetle, *Phyllotreta striolata* (Fabr.), see article on The Cabbage, in this report.

A TRIAL OF HOSE NOZZLES.

The importance of some efficient spraying apparatus for distributing insecticides is becoming more and more appreciated by gardeners and fruit growers. As the success of any apparatus depends largely upon the nozzle used for distributing the liquid, and as several different forms of this necessary appurtenance have recently been placed upon the market, it was thought advisable to make a comparative test of the kinds that have been specially recommended for insecticide work.

The Climax nozzle, furnished by the Nixon Nozzle and Machine Company, of Dayton, Ohio, forces the stream through a disk of brass wire cloth, which breaks the jet into a spray of which the fineness is made adjustable by varying the mesh of the wire cloth. Where a sufficient head of water is available, this nozzle is capable of making a finer spray, considering its volume, than any other I have tested. For trees of medium size it must be regarded as one of the best. By removing the section containing the wire-cloth disk, it throws a constant stream and may be used as an ordinary hose nozzle.

Three forms of nozzles were tested that are designed to furnish a spray which may be adjusted to suit all kinds of work. One of these was the "Graduating Spray" nozzle, sold by the Field Force Pump Company, of Lockport, N. Y. The other two were the "Lowell Improved Spray Nozzles," Nos. 1 and 2, received from Mr. A. Hallowell, Lowell, Mass. For producing a moderately fine spray, and especially one that is projected to a considerable distance, all of these worked well. Two of them, however, viz., the first named and the No. 2 Lowell Improved, did not appear well adapted to create a fine and uniform spray. The difficulty appeared to arise from a mechanical defect in their manufacture, owing to which the stream when made very thin would not emerge from the whole circumference of the disk at once. The No. 1 did not show this difficulty and was capable of producing all gradations, from a very fine spray to a simple jet.

It seems to me doubtful if any of the nozzles here mentioned is superior for use on high trees to the "Boss" nozzle, mentioned in a previous report.*

AN EXPERIMENT WITH HOME-GROWN PYRETHRUM.

Seeds of *Pyrethrum roseum*, the plant from which the so-called Persian or Dalmatian insect powder is manufactured, were a few years since quite extensively distributed by the Department of Agriculture for trial in various parts of our country. The reports of the Department do not indicate that much attention was paid to them by the recipients. A package of seed from this source was received by this Station and planted in the spring of 1887. The plants did not bloom the first season and were counted as a failure. Contrary to expectations, however, they endured the winter without apparent harm, and early in the spring started a vigorous growth, which was soon followed by a profuse crop of blossoms.

It has been stated † that this plant, when grown in America, has been found to possess little of the poisonous property that renders it valuable as an insecticide. In order to test the truth of this statement, a quantity of the unopened blossoms was gathered and dried in a shaded part of the office, after which they were pulverized in a mortar. The strength of the powder as compared with samples of Buhach, an insecticide made from another species of *Pyrethrum* grown in California, was then tested by putting two grams of each in a large fruit jar, introducing live flies into the jars and noting the time required for the insects to become paralyzed. In seven trials, the flies placed in the jar containing the home-grown powder fell first four times; those in the one containing the Buhach twice, and in the other trial both fell together. It should be said that the Buhach powder used was taken from a box that had been purchased some months before, from the New York agent of the Buhach Producing and Manufacturing Company, and that had been opened, but the cover fitted tightly and I do not know that it had ever been left off for any length of time. The sample used was undoubtedly pure, but had probably lost some of its original strength. Its odor, however, indicated that it was still in good condition. On the other hand the Buhach was undoubtedly ground much finer on the average than the home-made powder. The latter was of a light-brown color, and its odor reminded one somewhat of that of the may weed, *Maruta cotula*, being quite distinct from that of the Buhach.

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* See Report New York Agricultural Experiment Station, 1885, page 219.

† Revue Horticole, 1888, page 148.

The plants of *Pyrethrum roseum* mentioned above continued to blossom abundantly for several weeks, and would possibly have yielded more flowers than they did had none been permitted to form seed. At date (November 5) they are still alive and apparently in excellent condition, each having a large tuft of foliage which is still fresh. The flowers, which are very showy and of various colors, were much admired by visitors. Indeed, the plant is well worth growing for the beauty of its blossoms alone.

SUMMARY.

In a limited trial Paris green was more effectual than the "Zoektein poison" or London purple as a preventive from injury by the codling moth.

Potassium sulphide has some value as a preventive of injury from the currant worm.

Kerosene, used in its pure state, was not injurious to the foliage of some plants, as the coleus and rose, while it was fatal to that of others, as the tomato and potato.

Kerosene may be successfully atomized with water by means of of simple apparatus. Its value as an insecticide when applied in this way was not definitely settled.

EXPERIMENTS WITH FUNGICIDES.

Potassium sulphide for the gooseberry mildew.

Potassium sulphide contrasted with soda hyposulphite and calcium sulphide for the apple scab.

POTASSIUM SULPHIDE FOR THE GOOSEBERRY MILDEW.

At the suggestion of Dr. J. C. Arthur,* formerly botanist to the Station, a series of trials was made with potassium sulphide as a preventive of injury from the disease of the gooseberry plant commonly known as "mildew," and due to a fungus parasite known to science as *Sphærotheca Morsuvæ* B. and C. The substance was applied in solution at the rate of one-half and one-fourth ounce to the gallon respectively, commencing May 3, or as soon as the leaves had begun to expand, and the application was repeated after every hard rain until July 24, nine sprayings having been made in all. The experiment was made upon a row of the Industry gooseberry containing five plants, and upon a plat of seedlings numbering 282 plants.

Toward midsummer the effect of the spraying became distinctly visible in the deeper green foliage and more rapid growth of the treated plants. On June 23 the two plants of the Industry gooseberry that received the sprayings were noted as being entirely free from mildew, with the exception of a trace of it observed on a single fruit, while the three not treated were quite badly affected. The fungus appeared as a downy coating near the termini of the new shoots and also upon the berries. The new growth as well as the crop of fruit was very perceptibly greater on the treated plants. At this time the bed of seedlings had not been perceptibly attacked by the fungus.

On July 16 the seedling plants were found to be considerably affected, and an examination showed that in the row treated with the sulphide, at the rate of half an ounce to the gallon, only one plant exhibited signs of mildew out of a total of sixty — about 1.7 per cent; in the row treated at the rate of one-fourth ounce to the gallon, three plants were affected out of forty-three — about 7 per cent, while in 133 plants not treated, fifteen were affected, or about 11.3 per cent.

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* For results secured with this substance by Dr. Arthur in 1887 see Report New York Agricultural Experiment Station, 1887, pp. 348–52.

As these plants were all seedlings from native varieties, and are not all subject to mildew, these figures are only an indication of the effects of the treatment and not a proof, for I do not know how many plants in the treated rows would have been affected had the applications not been made. There could be no question, however, as to the benefits resulting from the treatment. The sprayed rows were conspicuous for the richer green of their foliage as far as the plantation could be seen; and the row receiving the stronger solution showed somewhat greater vigor than the other. A part of this benefit, however, probably resulted from the influence of the sulphide in destroying or repelling the currant worm,* as the treated plants were noticeably less injured by this insect than the others. A part also may have resulted from the fertilizing effect of the potash applied.

In the latter part of the summer, after the spraying had been discontinued, the mildew increased on the treated plants, showing clearly that the applications were beneficial, and also that they must be continued throughout the growing season to confer their greatest benefit.

SODA HYPOSULPHITE CONTRASTED WITH POTASSIUM SULPHIDE AND CALCIUM SULPHIDE FOR THE APPLE SCAB.

In former reports † are given the results of experiments with soda hyposulphite for the apple scab, *Fusicladium dendriticum* Fckl. From these it appears conclusively that this substance as used, acted beneficially, but that it was not a complete remedy for this disease. It is very desirable that some substance be found that will prove more effectual in destroying the fungus without causing greater harm to the foliage. Two other compounds of sulphur, viz., potassium sulphide and calcium sulphide, were therefore tested the past season. The first trial was made with the potassium sulphide in solution, at the rate of half an ounce to the gallon, upon the crab apple tree treated for three seasons preceding with soda hyposulphite, as described in the experiments cited.

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* See note on Potassium Sulphide as a destroyer of insects.

† See Reports New York Agricultural Experiment Station, 1885, pages 231–2; 1886, pages, 177–8; 1887, pages 99–101.

The spraying, which was done with the so-called Little Gem force-pump fitted with a "Climax" nozzle, was made upon the west half of the tree only, and was commenced May 10, just as the leaves were expanding, and repeated after every hard rain until July 24 eight applications having been made in all.

The tree blossomed alike, apparently, on both the sprayed and unsprayed portions, but the crop of fruit matured was much larger on the sprayed part and, as the following figures will show, was of much better quality.

On September 12 a quantity of fruit was picked from the sprayed and from the unsprayed parts of the tree and each lot assorted into three classes, in order to determine their relative injury from the disease. In the first quality were put only fruits nearly or quite free from scab; in the second, those that were considerably scabby, but not so much as to distort their form or prevent them from acquiring their normal size and in the third those which were distorted in form or diminished in size by the growth of the fungus.* The results secured were as follows:

	Number of fruits examined.	Per cent in first quality.	Per cent in second quality.	Per cent in third quality.
Sprayed part	1,560	75.9	22.6	1.5
Unsprayed part	627	46.9	45.3	7.8

More than 627 fruits did not mature on the unsprayed part of the tree. On the sprayed part, however, many more than 1560 might have been gathered. If we ascribe the larger crop on the sprayed part to the influence of the application, it is evident that the figures express but a small part of the benefit resulting from the treatment. Aside from the difference in crop, the fruits on the unsprayed portion were inferior in size to those on the other part.

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* This classification is necessarily somewhat arbitrary, but as the assorting was done with care, it is believed that the figures represent the true proportions of the amount of injury wrought by the scab. Almost all the fruits were somewhat scabby in the cavity about the stem, but if not affected elsewhere this did not exclude them from the first quality.

A comparison of the results secured the past season with potassium sulphide, with those secured on the same tree in 1885 and 1887 with soda hyposulphite, would indicate that the former proved the more effectual. Such a comparison, however, may not be just.

In a second trial, ten trees of the Fall Pippin apple were treated, as above described, with solutions of three compounds of sulphur, viz.: soda hyposulphite at the rate of an ounce to ten gallons, potassium sulphide at the rate of half an ounce to the gallon, and calcium sulphide in a saturated solution, the sprayings in every case being made on the same day and in the same manner. The trees were divided into three series, the first, fourth and seventh forming one series, the second, fifth, eighth and ninth forming the second, and the third, sixth and tenth the third series. The first spraying was given June 5, by which time the leaves were well expanded. Other sprayings were made June 16, June 27 and July 2, each of which shortly succeeded a hard rain.

On September 21 the fruits on the sprayed and unsprayed portions of each of the ten trees were picked, with the exception of a belt about three feet wide across the center of the trees where the sprayed and unsprayed parts were supposed to meet. The apples were then assorted into three qualities, as described in the case of the crab-apple tree, with the following results:

		Number of fruits examined.	Per cent in first quality.	Per cent in second quality.	Per cent in third quality.
First series, soda hyposulphite.......	Sprayed part......	495	56.56	27.01	16.43
	Unsprayed part...	397	46.85	27.96	25.19
Per cent in favor of sprayed part..	....	......	9.71	......	8.76
Second series, potassium sulphide...	Sprayed part......	960	31.35	40.11	28.54
	Unsprayed part...	247	22.67	36.03	41.30
Per cent in favor of sprayed part...	....	......	8.68	......	12.76
Third series, calcium sulphide.......	Sprayed part	315	28.26	40.95	30.79
	Unsprayed part...	129	37.21	33.33	29.46
Per cent in favor of *unsprayed* part..	....	......	8.95	......	.67

From this trial it does not appear that the potassium sulphide was decidedly more effectual than the soda hyposulphite, although as applied it contained about fifteen times as much sulphur. The soda hyposulphite as applied injured the foliage somewhat, and evidently could not be safely used in a stronger solution.

The calcium sulphide* apparently did no good whatever. This substance is only very sparingly soluble in cold water, which may account for its inaction. The fact that the sprayed part, when treated with this substance, showed so much greater percentage of injury than the unsprayed, throws a possible doubt over the whole trial, for we can not suppose that this compound of sulphur could have favored the growth of the fungus.

CONCLUSIONS.

The results of these tests appear to warrant the following conclusions:

First. That soda hyposulphite and potassium sulphide as applied proved beneficial in preventing injury from the fungus. This conclusion is strengthened by the results secured in previous experiments already cited.

Second. The tests do not prove that the greater amount of sulphur added in the potassium sulphide, as compared with the soda hyposulphite, rendered this substance the more effectual, though there are indications in this direction.

Third. That calcium sulphide is of little or no value for the purpose used.

Fourth. That while further experiments are needed to furnish data from which we may compute the actual benefits conferred by the treatments, the indications are that the good accomplished was sufficient to warrant the slight cost of the materials† in the case of orchardists who spray their trees for the codling moth.

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* Calcium sulphide was also used for the gooseberry mildew, but without perceptible effect.

† These substances may be purchased at the drug stores, the soda hyposulphite at six to ten cents per pound and the potassium sulphide at twenty-five to sixty cents per pound, according to the quantity and place of purchase. The former is readily soluble in cold water, the latter is better dissolved in a small quantity of warm water and then added to the water used for spraying.

THE POTATO — A TEST OF VARIETIES AND REPORT OF EXPERIMENTS.

A test of varieties.

Cuttings versus whole tubers of the same weight.

Sprouted versus unsprouted seed tubers.

The influence of treatment of the seed tuber upon the earliness of the crop.

Fertilizer below versus fertilizer above the seed tuber.

The consumption of the seed tuber by the plant.

Conclusions.

A TEST OF VARIETIES.

Forty-nine of the varieties of potato grown at the Station in 1887 were planted again the past season with forty-eight varieties or seedlings not before tested.

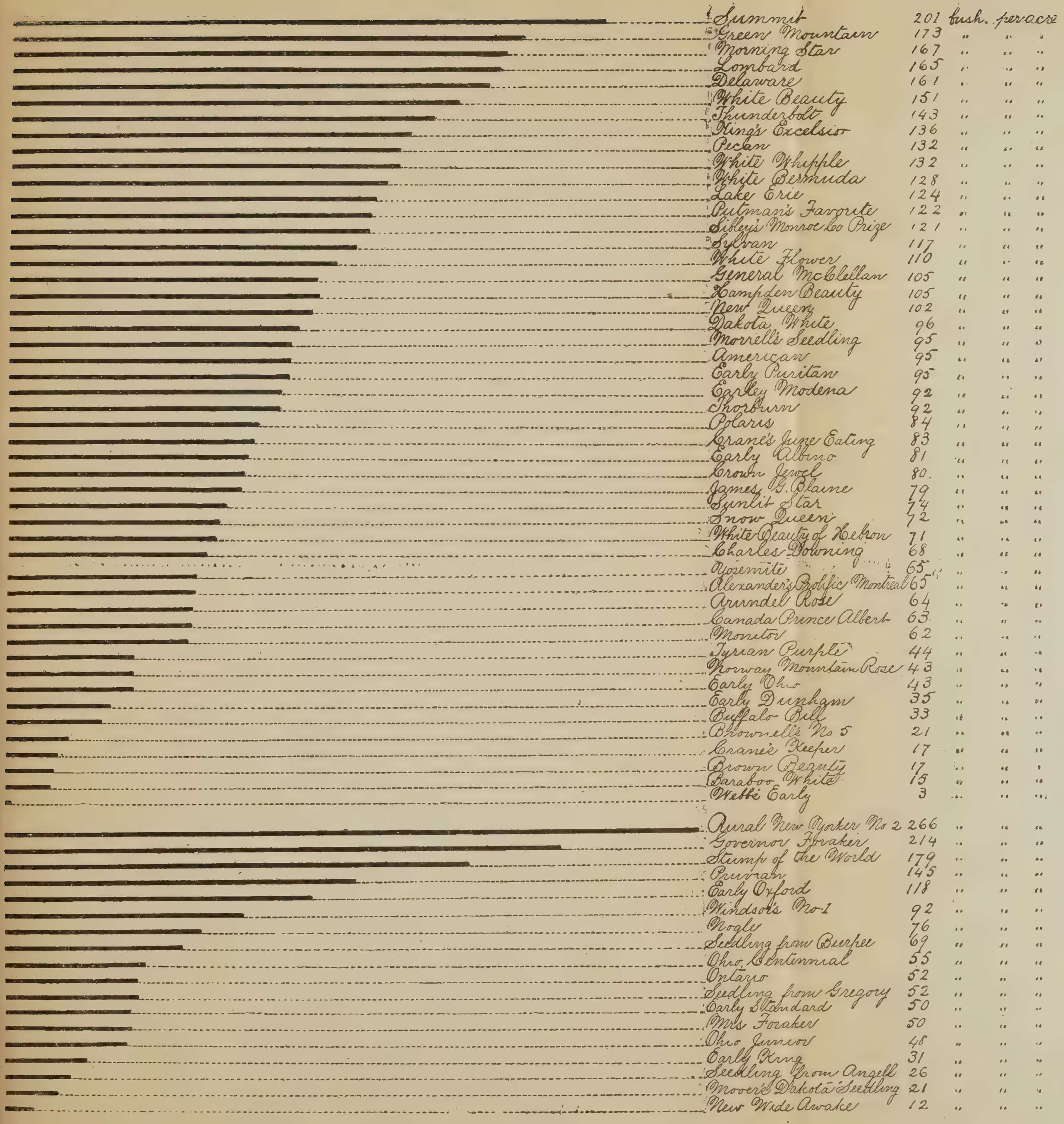
Observation has convinced me that in our former tests of varieties of the potato, the number of eyes planted has, in nearly every case, been too small to give reliable data as to the comparative productiveness of different sorts. The past season, therefore, the number was largely increased, except in a few cases, where only one or two tubers were sent for trial.

The forty-nine varieties grown in 1887 were planted on soil in a moderate state of fertility, but well-dressed in the spring with stable manure. The seed was single eyes, placed one foot apart, in drills four feet apart, and was covered with two large or three small hoefuls of earth.

The eighteen sorts not before tested were planted in the garden on very fertile soil, the seed, which was single eyes, being placed one foot apart as in the other case, but the drills were three and a half feet apart.

As in former reports, the yields given in the table are calculated on the basis of one hundred hills. As the eyes planted were, in most cases, nearly one hundred, such a calculation multiples the errors but slightly. As the varieties tested in the garden can not strictly be compared to the others, the data for these are given by themselves.

A somewhat less accurate but more lucid method of presentation has also been adopted for the benefit of those who do not


Summit 201 bush. per acre
Green Mountain 173 " " "
Morning Star 167 " " "
Lombard 165 " " "
Delaware 161 " " "
White Beauty 151 " " "
Thunderbolt 143 " " "
King's Excelsior 136 " " "
Pecan 132 " " "
White Whipple 132 " " "
White Bermuda 128 " " "
Lake Erie 124 " " "
Putman's Favorite 122 " " "
Sibley's Monroe Co Prize 121 " " "
Sylvan 117 " " "
White Flower 110 " " "
General McClellan 105 " " "
Hampden Beauty 105 " " "
New Queen 102 " " "
Dakota White 96 " " "
Morrell's Seedling 95 " " "
American 95 " " "
Early Puritan 95 " " "
Earley Modena 92 " " "
Thorburn 92 " " "
Polaris 84 " " "
Crane's June Eating 83 " " "
Early Albino 81 " " "
Crown Jewel 80. " " "
James G. Blaine 79 " " "
Sunlit Star 74 " " "
Snow Queen 72 " " "
White Beauty of Hebron 71 " " "
Charles Downing 68 " " "
Yosemite 65 " " "
Alexander's Prolific Montreal 65 " " "
Arundel Rose 64 " " "
Canada Prince Albert 63 " " "
Monitor 62 " " "
Tyrian Purple 44 " " "
Norway Mountain Rose 43 " " "
Early Ohio 43 " " "
Early Dunham 35 " " "
Buffalo Bill 33 " " "
Brownell's No 5 21 " " "
Crane's Keeper 17 " " "
Brown Beauty 17 " " "
Baraboo White 15 " " "
Webb's Early 3 " " "
Rural New Yorker No 2 266 " " "
Governor Foraker 214 " " "
Stump of the World 179 " " "
Pruvian 145 " " "
Early Oxford 118 " " "
Windsor's No 1 92 " " "
Nogle 76 " " "
Seedling from Burpee 69 " " "
Ohio Centennial 55 " " "
Ontario 52 " " "
Seedling from Gregory 52 " " "
Early Standard 50 " " "
Mrs Foraker 50 " " "
Ohio Junior 48 " " "
Early King 31 " " "
Seedling from Angell 26 " " "
Moore's Dakota Seedling 21 " " "
New Wide Awake 12 " " "

care to study results from the table. The horizontal lines represent the comparative merchantable yields of the different varieties and are based on the figures given in the table. The yield per acre given at the right, which is necessarily only approximately accurate, also represents the merchantable product, but the number of bushels is calculated on the exact yield secured from the different rows in order to reduce errors to the minimum.

In the varieties in which the date of dying of the tops is not noted, the foliage continued green until the first hard frost, which occurred October 12.

The different varieties were tested upon the table, so far as time permitted.

	Date planted.	Number of eyes planted.	Tops dead.	CALCULATED ON THE BASIS OF ONE HUNDRED HILLS.						Table quality.
				Number merchantable.	Weight of merchantable.		Total number.	Total weight.		
					Lbs.	Ozs.		Lbs.	Ozs.	
Alexander Prolific Montreal	May 10	90		118	35	9	407	64	7	2
American	May 10	90		139	52	8	256	64	7	2
Arundel Rose	May 10	90	Sept. 29	106	35		299	53	14¼	2
Baraboo White	May 10	77	Sept. 29	34	8	7	218	30	3	3
Brown Beauty	May 10	90	Sept. 20	36	9	2¾	204	25	9	3
Brownell's No. 55	May 10	90	Oct. 5	58	11	10¾	307	33	1	2
Buffalo Bill	May 10	90	Sept. 20	82	18	1	304	35	4½	3
Canada Prince Albert	May 10	90	Sept. 20	244	34	11½	488	55	9	2
Charles Downing	May 10	90	Sept. 13	144	37	3½	367	55		2
Crane's June Eating	May 10	90	Sept. 13	167	45	13¼	467	68	1	2
Crane's Keeper	May 10	90	Sept. 21	40	9	7	162	18	5¼	2
Crown Jewel	May 10	90	Sept. 1	159	43	14¼	576	77	3½	2
Dakota White	May 10	90	Sept. 29	156	52	12½	370	76	15	
Delaware	May 10	90		192	88	14	316	104	7	1
Early Albino	May 10	90	Sept. 1	144	44	7	440	64	11½	
Early Dunham	May 10	90	Sept. 21	62	19	7	362	43	14¼	4
Early Modena	May 10	90		153	50	13¼	407	91	10¾	2
Early Ohio	May 10	90	Aug. 25	00	23	14¼	249	33	1	
Early Puritan	May 10	90	Sept. 20	174	52	3½	470	78	1	
General McClellan	May 10	90		150	57	12½	294	74	1	3
Green Mountain	May 10	90		200	95	4½	362	115	4½	3
Hampden Beauty	May 10	90	Aug. 27	178	57	12½	387	70	13¼	3
James G. Blaine	May 10	90	Aug. 27	153	43	5¼	369	56	10¾	
King's Excelsior	May 10	90		210	74	11½	341	89	7	3
Lake Erie	May 10	90		179	68	5¼	359	91	10¾	2
Lombard	May 10	90	Sept. 29	187	91	1¾	349	109	11½	3
Monitor	May 10	90	Sept. 22	107	33	14¾	313	47	12½	2
Morning Star	May 10	90	Oct. 5	219	92	3½	350	105	9	2
Morrell's Seedling	May 10	90		140	52	8	266	65		
New Queen	May 10	90	Sept. 20	144	56	1¾	382	85	13¼	2
Norway Mountain Rose	May 10	90	Sept. 15	96	23	14¼	327	40	4½	
Pecan	May 10	90	Sept. 29	211	72	12½	596	111	15	2
Polaris	May 10	90	Sept. 15	149	46	6¼	497	75	13¼	
Putman's Favorite	May 10	90	Oct. 5	199	67	3½	470	90	13¼	4
Sibley's Monroe County Prize	May 10	90	Oct. 5	166	66	15	341	87	12½	2
Snow Queen	May 10	90	Sept. 20	131	39	7	378	58	14¼	
Summit	May 10	90	Sept. 29	272	110	4½	563	143	5¼	
Sunlit Star	May 10	90	Sept. 22	129	40	9	318	57	12½	2
Sylvan	May 10	90		173	64	7	367	89	2¾	
Thorburn	May 10	90	Sept. 22	167	50	9	489	74	7	2

	Date planted.	Number of eyes planted.	Tops dead.	CALCULATED ON THE BASIS OF ONE HUNDRED HILLS.						Table quality.
				Number merchantable.	Weight of merchantable.		Total number.	Total weight.		
					Lbs.	Ozs.		Lbs.	Ozs.	
Thunderbolt	May 10	90	....	210	78	14¼	744	129	7	3
Tyrian Purple	May 10	90	Sept. 22	107	24	2¾	458	53	14¼	4
Webb's Early	May 10	90	Oct. 5	5	1		18	2		
White Beauty	May 18	90	....	164	83	5¼	244	93	14¼	4
White Beauty of Hebron	May 18	90	Oct. 5	109	38	14¼	256	55		
White Bermuda	May 18	90	....	170	70	9	263	82	3½	3
White Flower	May 18	90	Sept. 29	184	60	13¼	350	78	9¾	3
White Whipple	May 18	90	Sept. 29	222	72	12½	527	112	12½	2
Yosemite	May 18	90	Sept. 20	116	35	13¼	427	75	4½	2
Early King	April 28	48	Oct. 5	52	15	1¾	144	20	5	2
Early Oxford	May 16	18	Oct. 5	189	56	15	417	77	12¼	2
Early Standard	April 28	24	Aug. 31	133	23	15¼	425	44	12¾	
Governor Foraker	April 28	96	Aug. 31	258	103	6¼	400	118		2
Mooer's Dakota Seedling	....	20	Sept. 24	70	10		275	22	8	
Mrs. Foraker	April 28	96	Before Aug. 25	117	23	15¼	775	70	13¼	
New Wide Awake	April 28	72	Aug. 25	36	5	14½	158	13	3	
Nogle	April 28	72	Before Aug. 25	144	36	13	457	58	11	
Ohio Junior	April 28	22	Before Aug. 25	91	23	4¾	173	27	13	
Ohio Centennial	April 28	15	Before Aug. 25	133	26	10¾	547	55		
Ontario	April 28	21	Before Aug. 25	133	25		752	65	7½	
Peruvian	April 28	34	Before Aug. 25	256	69	13¾	562	93	6	4
Rural New Yorker No. 2	April 28	13	....	308	128	13½	377	130	12¼	1
Stump of the World	May 18	24	....	296	86	7¼	479	106	25	2
Windsor's No. 1	April 28	30	Aug. 25	100	44	2¾	600	76	10¾	1
Seedling from C. E. Angell, No. 79	May 21	24	....	63	12	8	......	....		3
Seedling "No. 88," from W. A. Burpee,	April 28	24	....	125	33	5¼	287	42	11¼	2
Seedling from J. J. H. Gregory	May 11	15	Sept. 10	100	25		253	36	10¾	

The marked differences in the prolificacy of varieties grown under apparently equal conditions is most striking, and suggest to what an extent the profits or losses of potato-growing may depend upon the variety planted.

In addition to the above list, seven seedlings kindly sent to the Station by Mr. Charles F. Waugh, of Ovid, N. Y., were grown, two of which possess some promise. The yields of these are not reported in the table because the seed tubers arrived so late as to make the results quite incomparable with those of earlier plantings.

CONDITIONS OF THE EXPERIMENTS.

Except when otherwise stated, the potato experiments here detailed were performed on the main experiment plats of the Station, but in each plat alternate rows or drills were devoted to the different treatments under trial. This was done in order to eliminate the influence of soil variations in the different plats. The rows or drills were four feet apart, and there were eight to each plat, making four duplicate pairs. These rows or drills were 132 feet long in the tenth-acre plats and sixty-six feet long in the twentieth-acre plats.

These plats, which were in rather poor condition as regards fertility, were well plowed and harrowed, after which they were marked out with the ordinary corn-marker, and the marks were traversed with the corn-plow, making shallow furrows, in which the tubers or cuttings, in every case of the White Star variety, were dropped. The latter were then stepped on by the dropper and covered with two large or three small hoefuls of soil, when the hill was stepped on by the coverer. The plats were cultivated as often as they appeared to require it, until the tops commenced to spread, and at the last cultivation the rows or drills were hilled slightly to prevent the tubers from protruding out of the soil. The potato beetle was mastered with London purple mixed with land plaster.

CUTTINGS VERSUS WHOLE TUBERS OF THE SAME WEIGHT.

Object of the Experiment: To ascertain if anything is gained by cutting tubers for seed.

An experiment was made in 1886 and repeated in 1887* with whole tubers of various sizes as compared with cuttings, of which the average weight was the same as that of the whole tubers. The results not appearing conclusive, this experiment was repeated the past season on a larger scale, the area devoted to it comprising twelve main plats of one-tenth acre each — designated on the Station chart as B 2–4 and 6–14 inclusive.

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* See report New York Agricultural Experiment Station, 1886, pp. 151–3; 1887, pp. 86–7.

In preparing the seed, the number of cuttings required for one row was first made and their weight noted. The same number of whole tubers of nearly uniform size was then picked out and weighed. If their weight exceeded that of the cuttings the larger ones were replaced with smaller until their weights were equal, and *vice versa.*

The plats were planted May 2, the tubers or cuttings being placed twelve inches apart in the drills, and the crop was harvested October 10 and 11, at which time the tops were, with the exception of an occasional stalk, entirely dead.

In the following table the aggregate merchantable and total yields of the four rows planted with the cuttings and with the whole tubers in each plat are given separately, and also the differences in favor of each. The size of the cuttings planted in the different plats is noted at the right.

CUTTINGS VERSUS WHOLE TUBERS OF THE SAME WEIGHT.

NUMBER OF PLATS.	CUTTINGS.		WHOLE TUBERS.		DIFFERENCE IN FAVOR OF				
					CUTTINGS.		WHOLE TUBERS.		
	Merchantable.	Total.	Merchantable.	Total.	Merchantable.	Total.	Merchantable.	Total.	
B 2	180¼	211¼	135¾	191½	44½	19¾	....	....	Single eyes *vs.* whole tubers.
B 3	162¼	188½	167	196¾	....	....	4¾	8¼	Two eye cuttings *vs.* whole tubers.
B 4	223¾	243¼	214	244¾	9¾	....	....	1½	Two eye cuttings *vs.* whole tubers.
B 6	207½	230¼	205¾	233¾	1¾	....	....	3½	Three eye cuttings *vs.* whole tubers.
B 7	302½	330¼	277¾	312½	24¾	17¾	....	....	Three eye cuttings *vs.* whole tubers.
B 8	277¼	312	286	323	....	....	8¾	11	Three eye cuttings *vs.* whole tubers.
B 9	373¼	435¼	347	404¾	26¼	30½	....	....	Half tubers *vs.* whole tubers.
B 10	333¼	381¼	318¼	369½	15	11¾	....	....	Half tubers *vs.* whole tubers.
B 11	405¼	447¾	367¼	418	38	29¾	....	....	Half tubers *vs.* whole tubers.
B 12	345¾	386¼	370½	414½	....	....	24¾	28¼	Half tubers *vs.* whole tubers.
B 13	296½	344	323¾	374¾	....	....	27¼	30¾	Half tubers *vs.* whole tubers.
B 14	239	283¼	255	309½	....	....	16	26¼	Half tubers *vs.* whole tubers.
Total difference					160	109½	81½	109½	
Net difference					**78 1-2**				

As appears from the table, in five plats the yield from the cuttings exceeded that from the whole tubers, while in the same number of plats the reverse was the case. In two plats the merchantable yield was greater from the cuttings, while the total yield was greater from the whole tubers. The sum of the differences shows an excess of merchantable tubers in favor of the cuttings of 78½ pounds, while the total yields were equal. This indicates a slightly greater tendency of the whole tubers to produce small potatoes. When we take into consideration, however, the amount of ground covered by the experiment (one and one-fifth acres), it is evident that these differences are too small to be seriously considered. Two series of plantings of six-tenths of an acre each could hardly be expected to yield more nearly equal amounts, even if similarly treated in all respects. In 1886 the result of a similar experiment showed a slight difference in favor of the cuttings. The average of the experiments, however, does not warrant the conclusion that either method of seeding is more conducive to yield than the other.

It is possible that the number and magnitude of the experiments are not sufficiently large to justify a final conclusion, but so far as their teachings go, we may infer that, under conditions like those of the Station, little or nothing is gained by using cut potatoes for seed, while the labor of cutting and the greater market value of the larger tubers may constitute a positive loss.

SPROUTED VERSUS UNSPROUTED SEED TUBERS.

Object of the Experiment: To ascertain the loss in crop that results from planting sprouted tubers.

A Plat Experiment.

Last March, before the potatoes in the cellar had commenced to sprout, a sufficient quantity of seed tubers of medium size were selected to plant four plats of one-twentieth acre each. The tubers intended for each row were selected separately, and in order that each pair of rows might be strictly comparable, they were so selected that the number and weight of the tubers in the two rows were equal. The seed tubers intended for one row of each pair were then placed in a covered box in the office attached to the green-house, where the warm and moist atmosphere caused the eyes to start rapidly, and the others were deposited in a cooler part of the cellar.

On May 9 the tubers of both lots were cut into halves lengthwise and planted on main plats F 13–16 inclusive, the cuttings being placed two feet apart. At this time the shoots on the tubers taken from the green-house office were four to six inches long, while in those taken from the cellar, the eyes had scarcely started.

In plats 13 and 14, care was taken not to injure the shoots in cutting and planting, but in the other two plats no pains were taken in this regard. The crop was harvested October 15. In the following table, the yields of the four rows planted with the sprouted tubers and with those not sprouted, are given separately for each plat, and at the right the differences in favor of each are noted.

PLAT.	SPROUTED.		NOT SPROUTED.		DIFFERENCE IN FAVOR OF			
					SPROUTED.		NOT SPROUTED.	
	Merchantable.	Total.	Merchantable.	Total.	Merchantable.	Total.	Merchantable.	Total.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
F 13	161½	176	190	213	......	......	28½	37
F 14	205	219½	230½	242¾	......	......	25½	23¼
F 15	199	218½	210¾	224	......	......	11¾	5½
F 16	139½	152¾	133	147¼	6½	5½	......	......
Total differences					6½	5½	65¾	65¾
Net difference in favor of seed not sprouted							**59 1-4**	**60 1-4**

As appears, the sprouted tubers yielded less than the others, the difference amounting to about one bushel on the area grown—one-tenth of an acre. This was at the rate of 10 bushels per acre for the crop received, or about 8½ per cent of the whole merchantable yield. This difference, though less than was anticipated, is sufficient to justify the rejection of tubers that have formed shoots of considerable length for seed.

The figures indicate that in this case no advantage was gained by taking care not to injure, in planting, the shoots that had formed on the sprouted tubers.

A Laboratory Experiment.

In order to ascertain if any perceptible part of the stored nutriment of the potato tuber is expended in forming shoots before planting, 10 sound tubers were selected on February 28 and cut into halves lengthwise. The two halves of each tuber were then given a number, and the weight of each piece was noted. One piece of each tuber was put into the drying oven at once, in order to determine its percentage of dry matter at this time. Of the remaining pieces, 5 were placed in a cool part of the cellar, where they would not sprout, and the remaining 5 were packed in damp moss and placed in the green-house. By March 29 the pieces placed in the green-house had formed shoots one to three inches long. They were, therefore, placed in the drying oven with those from the cellar, of which the eyes had not started. A comparison of the dry matter of the pieces from the cellar with that of those placed in the green-house, and which had formed shoots as above mentioned, indicated that the latter had lost on the average 2.065 per cent of their dry matter, which we may ascribe to chemical changes incident to the growth, as the sprouts were in every case dried with the tubers.

THE INFLUENCE OF TREATMENT OF THE SEED TUBER UPON THE EARLINESS OF THE CROP.

Object of the Experiment: To ascertain if the time of maturity may be hastened by

1. Exposing the seed tubers to light and warmth.
2. Removing the "seed" end.

Exposing the Seed Tubers to Light and Warmth.

It has often been stated that the time of maturity of potatoes may be hastened somewhat by exposing the seed tubers to the light in a warm room for a time before planting, the theory being that the starting of the eyes into short thick shoots favors their rapid development in the soil. An experiment was therefore made, intended to show the truth or fallacy of this claim.

On March 29 a sufficient quantity of tubers was selected to plant four plats of one-twentieth acre each. These were so selected that the same number and weight of tubers were planted in each pair of rows intended for comparison. The tubers selected for one row of each pair were then placed on the floor of the room over the dairy, which was kept at a moderately warm temperature and is well lighted. The others were placed in a cool part of the cellar.

On May 5 both lots of tubers were planted on main plats F 3–6, inclusive.

The results, both as to earliness and yield, were negative. The tops of the rows planted with the tubers exposed to light and warmth did not die earlier than those of the others, so far as could be discovered. In the yield the difference was very slight, only about twenty-one pounds of merchantable potatoes on the one-twentieth acre. This slight difference was in favor of the tubers exposed to the light.

Removing the Seed End.

It has been asserted that the maturity of potatoes may be hastened by cutting off the end of the seed tuber opposite to the stem.

An experiment made upon main plats G 9 and 10 did not confirm this proposition. The plats were planted May 16 with tubers of medium size, those planted in alternate rows having the "seed" ends removed, and the remainder having an equal amount cut from the opposite end, the tubers being placed two feet apart. No difference was perceptible in the time of dying of the tops. The yield showed an excess in favor of retaining the "seed" end of 28 pounds on the one-twentieth of an acre, which in this case was nearly 20 per cent of the whole crop.

The pieces cut off were also planted with very similar results, that is to say, there was no perceptible difference in the time of maturity, and the "seed" ends yielded somewhat more than the stem ends.

The results of these trials agree with those secured in a previous experiment* in the use of the seed and stem end of tubers for planting.

FERTILIZER BELOW VERSUS FERTILIZER ABOVE THE SEED TUBER.

At the suggestion of Mr. E. S. Carman, of the *Rural New Yorker*, an experiment was made to ascertain whether fertilizer placed below or above the seed tuber is more conducive to yield.

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* See Report New York Agricultural Experiment Station, 1882, pp. 122–4.

Five main plats, designated on the Station chart as D 10–14, inclusive, containing one-twentieth acre each, were devoted to this experiment. The marks made by the corn-marker were furrowed by traversing each one twice with the plow, turning the soil in opposite directions.

Commencing with the first furrow in each plat and following with each alternate one, 6¼ pounds of "New Process Special Potato Fertilizer" were strewn in the bottom of the furrow. This application was at the rate of 1,000 pounds per acre. The fertilizer was then mixed with the soil by means of the hoe, after which half tubers, from medium-sized potatoes cut lengthwise, were dropped in the drills two feet apart, and each cutting covered with two large hoefuls of soil.

In the intermediate rows the cuttings were placed in the bottom of the furrow and each one covered with one hoeful of soil, after which the same amount of fertilizer was applied, when each cutting received an additional hoeful of soil. The planting was commenced May 8, but the wind rising before it was completed, which prevented the application of the fertilizer, had to be postponed until the following day.

In the subjoined table are given separately the yields of the four rows of each plat receiving the two methods of fertilizing, and at the right the differences in favor of either method.

PLAT.	FERTILIZER BELOW.		FERTILIZER ABOVE.		DIFFERENCE IN FAVOR OF			
					FERTILIZER BELOW.		FERTILIZER ABOVE.	
	Merchantable.	Total.	Merchantable.	Total.	Merchantable.	Total.	Merchantable.	Total.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
D 10	90	123½	93½	130¼	......	......	3½	6¾
D 11	148¼	176	124	145	24¼	31	......	......
D 12	144¾	178½	135¾	151¾	9	26¾	......	......
D 13	169¾	192½	169½	191½	¼	1	......	......
D 14	193¾	216¼	178¾	201	6	15¼	......	......
Total difference					39½	74	3½	6¾
Net difference in favor of fertilizer below the seed					**36**	**67 1-4**		

As appears, the yield was somewhat larger from the drills in which the fertilizer was placed below the seed, the difference amounting to 36 pounds of merchantable potatoes on one-twentieth of an acre, or 4 bushels 48 pounds per acre.

From one experiment, however, this difference is too small to be seriously considered, as we should regard two acres similarly treated that yielded so nearly alike as little else than duplicates, at least until the case were strengthened by several trials.

THE CONSUMPTION OF THE SEED TUBER BY THE PLANT.

Object of the experiment: To ascertain the cause of the more rapid consumption of the seed tuber on rich than on poor soil.*

It has been shown in the places cited that the stored nutriment of the seed tuber was more rapidly consumed on rich than on poor soil. The only reason for this fact that occurred to me, was the assumption that the plants on the poor soil, being less abundantly supplied with moisture than those on the rich soil, were restricted in their power to appropriate the patrimony furnished them in the seed tuber.

As a test for this hypothesis, two short rows of tubers, of known weight and dry matter content, were planted on the poor soil used in the preceding experiments in this connection, and when the plants had made some growth one of the rows was mulched with a layer of washed sand about an inch in thickness. Thus the two rows were under equal conditions, with the exception that the mulched row was better supplied with moisture.

Three tubers dried at the time of planting were found to contain 21.72 per cent of dry matter. On July 7, two seed tubers removed from the row mulched with sand were found to contain 6.13 and 6.24 per cent of dry matter respectively, while two removed from the row not mulched contained 8.82 and 8.93 per cent respectively, showing that the consumption was considerably faster in the mulched rows.

From the time the rows were mulched until the seed tubers were removed, there was but one period during which the ground was sufficiently dry so that crops appeared to suffer. We are justified in the inference therefore, that the slower appropriation of the seed tuber by the plant growing on the poor soil, noticed in the experiments cited at the beginning of this article, was due to the dearth of moisture.

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* See Report New York Agricultural Experiment Station, 1886, pp. 158-9; Agricultural Science II, p. 27.

CONCLUSIONS.

Little or nothing was gained by using cut potatoes for seed, over whole tubers of the same weight.

Seed tubers badly sprouted yielded about 8½ per cent less than unsprouted ones.

The earliness of the crop was not influenced by exposing the tubers to light and warmth before planting.

The yield was materially reduced by removing the seed end of the planted tubers.

Fertilizer placed below the seed may be slightly preferable to fertilizer placed above it. The fact was not clearly established.

The more rapid consumption of the seed tuber on rich than on poor soil is probably due to a more abundant supply of moisture.

THE INFLUENCE OF THE DEPTH OF TILLAGE UPON THE DEPTH OF ROOTS.

In a former experiment* it was observed that the roots of corn plants grown in pits, filled with fertile soil, made a large development a foot or more below the surface, while the average depth of the roots of corn under ordinary conditions is decidedly less than this. This suggested the question whether the depth of tillage may not, in some degree, influence the depth of roots.

With the hope of throwing light upon this question, five small plats were prepared on May 26 in the following manner:

No. 1 was worked two and a half feet deep; No. 2, two feet; No. 3, one and a half feet; No. 4, one foot, and No. 5, six inches deep. In working the plats the surface soil and subsoil were well mixed, so that the soil was left nearly uniform to the depth worked. The plats were then planted with Waushakum corn, in rows three feet apart both ways.

On September 12 the roots of sample plants on all of the plats were washed out and examined. Although some roots on all reached to the depth of two and a half feet, a larger proportion reached to that depth on the deeply worked than on the shallow worked plats. The proportion of shallow roots on the other hand was greatest on the shallow worked plats. On the deeply worked plats, the horizontal roots were very few. The roots appeared to diverge as they extended downward, reaching their greatest extent many inches below the surface, while in the shallow worked plats many roots grew nearly horizontal, so that the roots on these plats reached their greatest extent but a very few inches below the surface.

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*See Report New York Agricultural Experiment Station, 1887, pp. 95–6.

The ground occupied by the roots might be represented in the deeply worked plats by a short cone buried just beneath the surface, in its upright position, while in the shallow worked plats the cone would need to be inverted.

The differences noted in the root growth correspond well with the observations upon the growth of the plants made during the summer. During June and the early part of July, before the soil had become very dry, the corn grew most rapidly on the shallow worked plats. In August, however, during a period of severe drought, the plants on the deeper worked soil overtook and surpassed the others. The rich green foliage and vigorous appearance of these plants presented a striking contrast with the rolled and withering leaves of the plants on the shallow worked soil. Toward the end of summer a regular gradation in the height of the plants was noticeable, as well as in their stage of maturity, the tallest and least mature plants being those on the deepest worked plat. All, however, ripened before frost.

The yield of the different plats, which may have some interest, is given below. It appears that the deepest and most shallow tillage gave the largest yield of corn, while the shallow tilled plats gave the smallest yield of stalks :

PLAT.	Number of stalks.	Number of ears	Weight of ears.	Weight of stalks.
			Lbs.	Lbs.
Worked two and one-half feet deep	24	28	10	11¾
Worked two feet deep	24	23	7¾	10
Worked one and one-half feet deep	23	23	8½	10¼
Worked one foot deep	24	24	7	7
Worked six inches deep	24	26	9⅜	8

From this experiment and the one cited from our report for 1887, we are justified in believing that in soil like that of the Station, the depth of corn roots is influenced to some extent by the depth of tillage. The indications are that the distribution of roots depends rather more upon the presence of a proper supply of oxygen in the soil than upon a given degree of warmth. The deep tillage doubtless produced and favored the maintenance of a thorough aëration of the soil to the depth worked.

EXPERIMENTS IN THE CULTIVATION OF CORN.

The effects of root mutilation considered alone.
Cultivation with respect to root-mutilation.
The amount of root injury accomplished by ordinary cultivation.
Conclusions.

The Effects of Root Mutilation Considered Alone.

Object of the experiment: To ascertain the effects of cutting the roots of young corn plants, as independent from the effects of stirring the soil — an experiment of 1887 repeated.

Main plats D 8 and G 14 were planted with Waushakum corn on May 22. Three kernels were placed in each hill — the hills two feet apart, in rows four feet apart. The soil was rather poor. It had been well prepared, but no fertilizer was applied. On June 9, the first, and each alternate row, of each plat were root-pruned by inserting a lawn-edger to the depth of 3 inches on the four sides of the hill, keeping 4 to 8 inches distant from the plants. The tool was used in such a way as to disturb the soil as little as possible, the aim being to cut the roots to the extent that is accomplished by thorough cultivation, and to do nothing else. The tallest plants at this time were about 5 inches in height. The soil was rather dry, but nearly half an inch of rain fell during the succeeding week.

On June 25 the root-pruning was repeated in the same manner as before. The plants were at this time about 10 inches tall, without raising up the leaves. The ground was not dry, as it was during a showery period, and very copious rains fell within the next three days. The conditions were extremely favorable, therefore, for the plants to recover from the effects of the root-pruning. The weeds were kept down during the season either by pulling them by hand or by cutting them with the scuffle-hoe, the latter penetrating the ground only about half an inch.

The crop was harvested October 22, with the following results:

CORN — THE EFFECT OF ROOT PRUNING THE YOUNG PLANT.

	Number of row.	ROOT-PRUNED.		Number of row.	NOT ROOT-PRUNED.	
		Weight of ears.	Weight of stalks.		Weight of ears.	Weight of stalks.
		Lbs.	Lbs.		Lbs.	Lbs.
Plat D 8	1	18¾	20¼	2	24¾	33
	3	20	20¼	4	25¼	30¾
	5	19	20¾	6	24½	31¼
	7	18¼	20¼	8	18½	20½
Totals for plat		76	81½		93	115½
Plat G 14	1	*22¾	25	2	31¼	32¾
	3	31¼	31¾	4	31¼	38
	5	25¾	33½	6	31½	28¾
	7	27	29½	8	33½	37¾
Totals for plat		106¾	119¾		127½	137¼
Totals for the two plats		182¾	201¼		220½	252¾
Excess in favor of rows not root-pruned					**37 3-4**	**51 1-2**

As two one-twentieth acre plats were devoted to this experiment, and one-half of the rows were root-pruned, the root-pruned rows measured one-twentieth of an acre. It appears, therefore, that, counting 80 pounds of the freshly-husked corn as a shelled bushel, the rows not root-pruned yielded at the rate of 9 bushels and 42½ pounds of shelled corn and 1,020 pounds of stalks per acre more than the root-pruned rows. In 1887,† with a drier season, the difference was much greater, amounting in the case of the corn to 20 bushels and 47 pounds.

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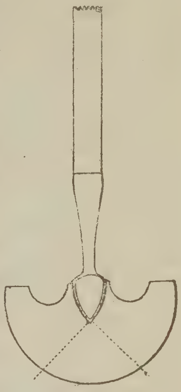
* The weight of corn in this row was lost through a mistake, but that of the unhusked shock was secured. The weight of the corn was therefore calculated from the weight of the shock by assuming that this row contained the same percentage of corn to the stalks as the other root-pruned rows.

† Report New York Agricultural Experiment Station, 1887, pp. 93–4.

As this experiment touches upon a subject of considerable importance to the farmer, it is thought well to add a few more words of explanation as to the method in which it was performed. All are not familiar with the lawn-edger. A drawing of it is therefore given. It consists of a thin blade of steel, attached to a suitable handle, the blade being in the form of a semi-circle and having its curved outer edge ground sharp. In the tool used the width of the blade at the points shown by the dotted lines was almost exactly 3 inches. In using it, the handle was held at an angle of 45°. With one surface of the blade facing the hill, the blade was inserted into the soil as far as the lower end of the shank, as shown at the intersection of the dotted lines, and at a point 6 or 8 inches distant from the hill. The blade was then thrust forward about a foot, taking care that it did not enter the soil further than the point of the shank, when it was withdrawn carefully so as to disturb the soil as little as possible. Near the end of the stroke thus made, the tool was inserted in the same manner, but at right angles to the first stroke. This operation was repeated until the hill was surrounded, the four strokes describing a square with the hill at its center. It is probable that every root crossing the line of these cuts was severed, but it was not possible that roots lying much below 3 inches deep could have been injured. As the soil was scarcely disturbed, very little of the benefit that accrues from cultivation could take place. We have, therefore, the effects of the root mutilation isolated.



[FIG. No. 2.]

We may fairly infer from the results of this experiment, taken in connection with those of the one cited from our last report, that only harm results from mutilating the roots of young corn plants. The question naturally arises then, "What is the proper method of cultivating corn?" for all will agree that some method of keeping the surface soil loosened is an absolute necessity. The following experiment was suggested by this question, but, as will appear, the results do not add to our knowledge.

CULTIVATION WITH RESPECT TO ROOT MUTILATION.

Object of the Experiment: To ascertain if that cultivation which secures the most thorough stirring of the soil with the least possible injury to the roots is not most conducive to the crop.

In this experiment three methods of treatment were compared, viz.: no cultivation, ordinary cultivation and what I will term ideal cultivation. In the first, the weeds were to be kept down by hand or with the scuffle hoe, but no further stirring of the soil permitted; in the second, the spaces between the rows were to be traversed twice in a place and at two different times with the ordinary corn cultivator in ordinary condition; that is to say, the cultivator not to be of the latest improved style nor in the best condition; in the third the soil to be stirred thoroughly to the depth of 5 or 6 inches in the parts of the spaces not occupied by the roots, but to the depth of only one inch where the roots were present. In the last method the shallow cultivation was to be accomplished by the garden rake, and the deep by means of the one-horse plow. At the first cultivation the plow was to be passed 4 times through each space, keeping at least 8 inches from the hills; at the last it was to be passed only twice through each space, keeping carefully at the center.

The experiment was carried out as planned. It occupied 12 plats of one-twentieth acre each, designated on the Station chart as C 1–11 inclusive, and D 1. As in the preceding experiment, individual rows were compared rather than individual plats. A portion of the rows, however, had to be rejected from the experiment, as those falling between the two methods of cultivation could not be treated alike on both sides. The tests were made in three series, as follows:

First series. No cultivation contrasted with "ordinary" cultivation.

Second series. No cultivation contrasted with "ideal" cultivation.

Third series. "Ordinary" cultivation contrasted with "ideal" cultivation.

The plats, on which no fertilizer was used, were planted May 21, the corn being dropped 2 kernels in a hill, the hills 2 feet apart in rows 4 feet apart. The first cultivations were performed June 8, when the corn was 4–5 inches tall, and the second and last

June 21, at which time the tips of the tallest leaves, raised upright, were about 22 inches from the ground.

The crop was harvested October 22, with the following results:

First series. No cultivation contrasted with "ordinary" cultivation:

	Yield of corn, lbs.	Yield of stalks, lbs.
Rows not cultivated	166	188¼
Rows receiving "ordinary" cultivation	170¾	210½

Second series. No cultivation contrasted with "ideal" cultivation:

Rows not cultivated	165½	223½
Rows receiving "ideal" cultivation	193	274¾

Third series. "Ordinary" cultivation contrasted with "ideal" cultivation:

Rows receiving "ordinary" cultivation	182	214
Rows receiving "ideal" cultivation	179¼	199¾

As the figures have little interest the yields of the different rows in each series are given collectively.

As appears, in the first series, the rows receiving no cultivation yielded almost as well as those receiving "ordinary" cultivation; in the second, those receiving "ideal" cultivation yielded decidedly better than those not cultivated, and in the third those receiving "ordinary" and "ideal" cultivation yielded about the same. As a whole, therefore, the results are quite inconclusive.

THE AMOUNT OF ROOT INJURY ACCOMPLISHED BY ORDINARY CULTIVATION.

In order to ascertain how much the corn roots were really injured by the "ordinary" cultivation in the experiment just described, a special examination was made on July 3. The cultivator used was one having an iron frame, with 5 reversible teeth which were much worn. The rows in which the test was made were 3½ feet apart, and the cultivator teeth were so set that the width cultivated was 25 inches. The cultivator had been passed but once in a place, which left a space of about 17 inches between the centers of each two rows nearly or quite undisturbed by the cultivator teeth.

The examination was made by carefully washing away, with a stream of water delivered through a hose, the soil loosened by the cultivator. On the whole, the injury done to the roots was less than I had suspected. Still the number of roots broken was considerable. Opposite one hill containing 2 stalks of corn 22 broken roots and fibers were counted. The largest of these, however, scarcely exceeded a cambric needle in diameter. In another place 25 broken roots and fibres were counted opposite to a hill containing but a single plant. The bottom of the track of the cultivator, when washed clean of the loose soil, revealed in some places many broken roots and fibers; in others none.

The cultivator teeth appeared to enter the soil about 3 inches.

CONCLUSIONS.

The first of these experiments confirms the results of last year and shows clearly that needless root cutting is injurious.

The second experiment failed to clearly determine the method of cultivation that is most conducive to crop.

The examination with respect to the injury to the roots affected by cultivation shows that even a cultivator in poor condition run once in a place cuts quite a large number of roots.

THE INFLUENCE OF THOROUGH AS CONTRASTED WITH SLACK PREPARATION OF SOIL.

An experiment was planned, which it is proposed to continue through a term of years, intended to illustrate the influence on yield of thorough, as contrasted with slack preparation of the soil, the differences in the treatment being reserved to the harrowing alone. The crop may be varied from year to year to suit circumstances. Fourteen one-twentieth acre plats, designated on the Station chart as main plats E 1–14 inclusive, have been set aside for this purpose. The treatment of these plats has not been similar during past seasons; hence it is not expected that the first few trials will yield much valuable data.

The plats were plowed as nearly uniformly as possible about May 10. On May 17, plat No. 2 was harrowed once with the

Acme harrow, plat No. 3 was harrowed twice with the same, No. 4 three times, No. 5 four times, and so on up to No. 7, which was harrowed six times. Then the order was reversed, No. 8 being harrowed six times, No. 9 five times, No. 10 four times, and so on to No. 14, which was not harrowed. All the plats were sown with White Russian oats May 23. The crop was cut August 20 and 21, drawn in August 24 and threshed about September 4. The yields were as follows :

No. of plat.	Yield of grain. Lbs.	Yield of grain. Oz.	Yield of straw. Lbs.	Yield of straw. Oz.
1	79	8	152	8
2	75	8	151	8
3	85	8	174	8
4	63	0	163	0
5	82	8	209	8
6	79	0	227	0
7	72	8	221	8
8	76	8	232	8
9	85	12	232	4
10	86	12	173	4
11	88	4	199	12
12	99	0	186	0
13	95	4	198	12
14	95	12	185	4

In this first trial of the experiment, on plats variously treated in past seasons, it should be no surprise if the yields do not follow preconceived ideas. Indeed, the ground plowed up so loosely in spring that the remark was made by different persons that it needed no harrowing. The yield of straw corresponds to some extent with the amount of labor expended in the preparation; that of the grain, however, does not. As further trials eliminate the influence of dissimilar treatment in the past, we may have opportunity to learn from this experiment how far yield responds to thorough preparation.

A single observation made in connection with this experiment is, however, quite suggestive. It was noticed all through the growing period of the crop that the appearance of plat No. 4 was decidedly inferior to that of either No. 3 or No. 5, and indeed to that of all the others. As indicated in the table, the yield both of grain and straw of this plat was quite inferior to that of its neighbors. The only difference in the treatment of plats Nos. 3, 4 and 5 since the establishment of the Station was that in 1887 plat No. 4 was permitted to grow up to weeds (intentionally), while Nos. 3 and 5 yielded a crop of maize. The three plats were plowed and planted alike with the maize, but after the plants had vegetated those on plat No. 4 were pulled out, leaving those on Nos. 3 and 5 to mature their crops. The weeds were permitted to grow undisturbed on No. 4 until autumn, when the growth on all the plats was removed. It appears, therefore, that the pernicious influence of weeds may not be confined to the season in which they grow, but that, at least when removed in autumn, they may injuriously affect the soil during the following season.

INVESTIGATIONS IN SOIL PHYSICS.

The influence of treatment upon soil moisture.

Details of the construction of new lysimeters.

The progressive movement of soil water during percolation.

Experiments on capillary action in soils.

The condensation of water upon the surface of soil during cold nights in spring.

The height of water in wells.

The soil hygrometer.

INTRODUCTORY.

Work in this department has been carried on the past season as time permitted. The investigations were brought to a sudden termination, however, on September 1, through the resignation of the assistant horticulturist, and were also restricted somewhat through inability to procure the needed apparatus.

Some of the results submitted may appear fragmentary. As the experiments were performed only as time could be spared from the horticultural department, it seemed useless to attempt a more systematic line of investigation.

THE INFLUENCE OF TREATMENT UPON SOIL MOISTURE.

Objects of the experiment.

1. To ascertain how far the amounts of moisture in the portion of the soil occupied by the roots of crops may be influenced by treatment aside from artificial watering.

2. To ascertain what depth of surface tillage retains the greatest amount of soil moisture.

3. To compare the effects of mulching with those of tillage in retaining soil moisture.

Main plat G 9, containing one-twentieth of an acre, of which the dimensions were 33 x 66 feet, was divided into ten plats of equal size, and these were grouped into two series of five plats each. The arrangement of these plats, as well as the treatment given them, is shown in the accompanying diagram:

No. 1. Suface neither mulched nor tilled. A.	**No. 2.** Surface stirred one-half inch deep. B.	**No. 3.** Surface stirred two inches deep. C.	**No. 4.** Surface stirred four inches deep. D.	**No. 5.** Surface mulched with short oats straw one inch deep. E.
No. 6. Surface mulched with short oats straw one inch deep. E.	**No. 7.** Surface stirred four inches deep. D.	**No. 8.** Surface stirred two inches deep. C.	**No. 9.** Surface stirred one-half inch deep. B.	**No. 10.** Surface neither mulched nor tilled. A.

As appears, plats 6–10 inclusive are duplicates of 1–5, with the exception that their order is reversed. This was done in order that each pair of duplicates might represent, as nearly as possible, an average of the whole main plat. The soil of this main plat is, for the first nine or ten inches, a clay loam, rather light in texture for the Station farm, but containing sufficient clay to make it bake somewhat in dry weather. Below this it is a very tenacious clay, generally of a light yellow color, but in spots inclining to bluish. The soil to the depth of a foot, is nearly free from large stones, but contains on the average about four per cent by weight of fine gravel that will not pass through a sieve of ten meshes to the inch.

The tillage on plats 2–4 and 7–9 inclusive was repeated after every rain sufficient to puddle the surface, as soon as the soil was dry enough to work. On plats 2 and 9, the garden rake only was used. On the other tilled plats the soil was thoroughly loosened with the spading fork to the required depth, after which the surface was made fine and level with the rake. Sometimes after slight rains the surface of all was raked over without using the fork. The weeds were pulled from the other plats as they required it.

Once each week, commencing May 15 and ending October 3, a sample of soil was taken to the depth of one foot, for drying, from each of the ten plats. The sampling was done with a tool resembling in form a butter tester, but much larger and stronger. It was made by splitting a section of one and a half inch steel tube through the center. The lower end of one piece was then rounded and made somewhat thinner, to form the point, and the edges were sharpened on the inside, while to the upper end a very strong shank, provided with a socket to receive a handle, was riveted.

In dry weather it was found impracticable to turn the tool about, preparatory to drawing it out, if inserted the whole twelve inches at once. The first insertion was therefore made to the depth of about six inches, and in the bottom of the hole thus formed, a second was made of such a depth that the two represented a cylinder of soil twelve inches long. The loose soil, that fell into the hole as the first section was drawn out, was rejected from the sample. In dry weather, the surface soil on the tilled plats was scraped away with the foot to the depth of a fourth or half an inch before taking the sample, it being assumed that this dry soil serves no purpose to vegetation except through its office as a mulch. As, in the mulched plats, the mulch itself was not included in the sample, it seemed hardly proper to include that part of the soil on the tilled plats which could act only as a mulch.

The samples from each pair of duplicate plats were placed in a fruit jar as they were drawn. The jars, which were sealed as they received the sample, to prevent evaporation, were then carried to the laboratory, where the soils, after being weighed, were exposed in a drying oven surrounded by water until they ceased to lose weight, after which each sample was washed through a sieve of ten meshes to the inch and the gravel and other matters that would not pass the sieve, dried, and their weights deducted from that of the fresh and dried sample. The per cent of moisture was then computed by dividing the loss of weight in drying by the net wet of the fresh sample.

In the following table, are given the percentages of moisture contained by the various samples for each week, with the weekly average for all the plats in the column at the right, and the average for each pair of plats through the season in the line at the bottom:

THE INFLUENCE OF TREATMENT UPON SOIL MOISTURE.

	Plats neither mulched nor tilled.	Plats stirred one-half inch deep.	Plats stirred 2 inches deep.	Plats stirred 4 inches deep.	Plats mulched.	**Average.**
Sample taken	A.	B.	C.	D.	E.	
May 15	18.6—	17.5+	17.3—	19.2+	19.1—	**18.42**
May 22	17.3—	17.5+	17.0—	16.7+	19.8—	**17.66**
May 29	17.8+	19.1+	18.4+	19.5+	18.7—	**18.70**
June 5	16.4—	16.9—	17.7—	16.4—	18.8—	**17.24**
June 13	14.6+	17.1+	16.2—	17.0+	18.2—	**16.62**
June 19	14.3—	16.0—	15.4—	16.3+	18.3—	**16.06**
June 26	17.3—	17.6+	17.7+	18.4+	20.9—	**18.38**
July 3	16.8+	17.5—	18.8+	18.9—	20.6+	**18.52**
July 10	15.6—	16.3—	17.0—	17.6—	19.5+	**17.20**
July 17	15.6—	15.9—	15.6—	17.1—	18.0+	**16.80**
July 24	15.0+	15.8—	16.6+	17.2—	19.4+	**16.80**
July 31	14.3—	15.4+	16.2+	17.2—	18.2+	**16.26**
Aug. 8	14.2—	15.1—	16.1—	16.1—	19.0+	**16.10**
Aug. 14	16.4—	17.5—	21.2—	20.4—	20.2+	**19.14**
Aug. 21	15.8—	16.8+	18.4+	18.0—	19.8+	**17.76**
Aug. 28	14.9—	16.2+	16.9—	17.7+	19.0+	**16.94**
Sept. 4	15.4—	16.0—	16.0—	16.7+	18.3+	**16.48**
Sept. 11	17.5+	17.5+	16.9+	18.6+	19.7+	**18.04**
Sept. 18	17.7—	19.6—	18.8—	20.5+	21.4+	**19.60**
Sept. 25	16.3+	17.3+	17.7+	17.7+	19.3+	**17.66**
Oct. 3	17.8—	20.0+	19.8+	20.8+	20.6+	**19.8**
Average	**16.19+**	**17.10—**	**17.41+**	**18.00**	**19.37+**	

A slight examination of the table shows clearly that, with very few exceptions, the plats neither mulched nor stirred contained the least moisture, while the moisture content increased regularly with the depth of the stirring and was greatest in the mulched plats. The bottom line of the table shows that, on the average, this gradation was uniform and marked.

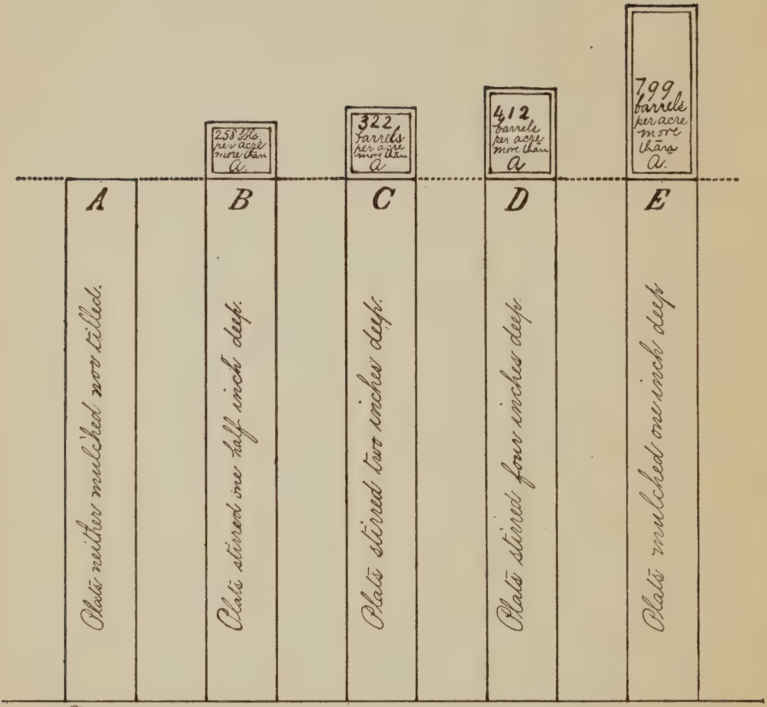
The influence of surface treatment assumes its chief importance in time of drought. In periods of abundant rainfall, it matters little to the farmer whether soil stirred one-half inch or four inches deep contains the more moisture. But when his crops are suffering from a dearth of water, he would gladly know how he may best mitigate the effects of the drought.

If we observe the average moisture content of all the plats during the different weeks, as given in the right hand column of the table, it appears that the four dates showing the lowest percentages were June 19, July 31, August 8, and September 4. During the week preceding each of these dates, then, if at all, the crops must have been suffering from drought.

In order to avoid needless repetition of words, the plats will be designated by the letters applied to them at the head of the columns in the table. Averaging the moisture percentages of the different plats for the four dates above mentioned, we have for A 14.55, B 15.625, C 15.925, D 16.575, and E 18.45.

If now we compute the excess of moisture in the other plats over A, we find that the per cent is for B 1.075, C 1.375, D 2.025 and E 3.9, from which it appears that keeping the surface stirred one-half inch deep retained 1.075 per cent of water that would otherwise have evaporated; that keeping it stirred two inches deep retained 1.375 per cent, four inches deep 2.025 per cent, and keeping it mulched one inch deep retained 3.9 per cent of water that would otherwise have been lost by evaporation. These differences may at first thought seem slight, but when we recall that the percentages are calculated upon the weight of the soil itself, their significance more readily appears, as computations given later will show.

On September 22, an exact cubic foot of soil was taken up on opposite sides of the main plat devoted to this experiment. By drying generous samples from these measured bulks of earth, it was ascertained that the dry weight of a cubic foot of the soil under experiment was approximately 89.7 pounds. Calculating on this basis, and reducing the water contents to depth inches, as we measure rainfall, it appears that the average amounts of water



The Influence of Treatment upon Soil Moisture contained in each cubic foot of the different plats during the four dryest weeks of the summer was for A 2.797 in., B 3.096 in., C 3.170 in., D 3.275 in., and E 3.72 in., from which it appears that the excess of the other plats over A was for B .299 in., C .3737 in., D .478 in. and E .923 in.

Expressing these excesses in cubic inches and in liquid measure, to make them more intelligible, it appears that the excess for each cubic foot of soil was in the case of:

B. 43.056 cubic inches, or very nearly 1½ pints.
C. 53.813 cubic inches, or nearly 1 quart.
D. 68.832 cubic inches, or more than 1 quart.
E. 132.912 cubic inches, or more than 2 quarts.

Expressing these excesses in barrels per acre, the number appears in the case of B 258 barrels, C 322 barrels, D 412 barrels and E 799 barrels.

The true relations of these numbers appear more clearly in the annexed illustration, which represents the depth of water in inches retained in each series of plats.

These figures clearly show that the amount of water retained in the soil in dry weather, by even a very shallow stirring of the surface, is by no means inconsiderable. It should be remembered that they do not represent the total amounts of water thus retained. That is to say, the experiment does not show simply that B lost 258 barrels of water per acre less than A during the four weeks under consideration. It shows rather that as the average of four observations, made during the four dryest periods of the summer, the soil of B was found to contain, incorporated within itself and available to plants, had plants been growing within reach of it, 258 barrels of water per acre more than that of A, while the other plats contained larger amounts than this. We may infer, therefore, that this excess of water was maintained throughout the periods of drought, despite the losses from evaporation.

The figures also show clearly that the amount of water retained by the stirring of the surface increased with the depth of the stirring, but not in proportion to its depth. It would appear that the first half inch of stirring retained more water than any succeeding one. This would indicate that there is a clearly defined limit to the depth of profitable cultivation. So long as the benefit to the crop, through the conservation of moisture, is greater than the injury accruing from root laceration, the cultivation is profitable; beyond this it may become unprofitable.

The influence of the mulch in retaining water in the soil is especially noticeable. The mulch used in this experiment was of fine oat straw that had served during the preceding winter in covering strawberries. Its depth did not exceed one inch after it had become packed a little by the rains, and it was not renewed during the season. It appears, however, that during the dry weather its efficacy in retaining water was almost double that of the deepest soil stirring used in this experiment, a fact which emphasizes the great value of mulching in its proper place.

CONCLUSIONS.

The results of this experiment warrant the following conclusions for the soil upon which it was made :

1. That keeping the surface of the soil stirred, if only to the depth of half an inch, increases the water content of the first twelve inches to a very appreciable degree.
2. That the deeper the tillage, at least up to four inches, the greater is the increase in water content.
3. That the rate of increase diminishes as the depth increases.
4. That a slight mulch exerts a far greater influence in retaining water than tillage four inches deep.

An observation made while excavating for a lysimeter in the latter part of August is appropriate here, as showing the depth to which surface tillage affects the water content of the soil. The excavation was made on a dry ridge, in order to escape bottom water, and on one side it reached into the corner of a plat that had been plowed in the spring, but upon which no crop had been planted, and which had not been cultivated during the summer. The soil it was necessary to remove was very dry and hard, except beneath this plowed portion, where it was so much moister and softer that the labor of excavation was very materially reduced. The influence continued to be noticeable to the depth of at least two feet.

DETAILS OF THE CONSTRUCTION OF NEW LYSIMETERS.

In the Station report for 1887, p. 113–14, is briefly described a new lysimeter, devised by Dr. Babcock and myself, which is believed to possess some important advantages over those in use at other experiment stations.

During the past season, four lysimeters have been constructed at the Station on the new plan. Unfortunately, they could not be put in sufficiently early so that any record of percolation and evaporation for the past summer could be secured. It is expected, however, that the soil within them will become well settled during the winter, so that they will be in condition to furnish valuable data next season.

As it is known that certain other experiment stations contemplate putting in lysimeters, it is thought that a description of those recently completed at our Station may prove of interest.

For the benefit of those who have not seen the description of the new lysimeter, as given in our last report, it is stated here that the new feature consists chiefly in supplying an artificial water table at the bottom of the column of soil, in order to furnish conditions more like those in the open ground. This water table is so arranged, that, while it is kept at a constant height, it does not interfere with the measurement of the percolation, and facilitates the measurement of the evaporation. The details of the arrangement will readily appear from the drawing accompanying this article.

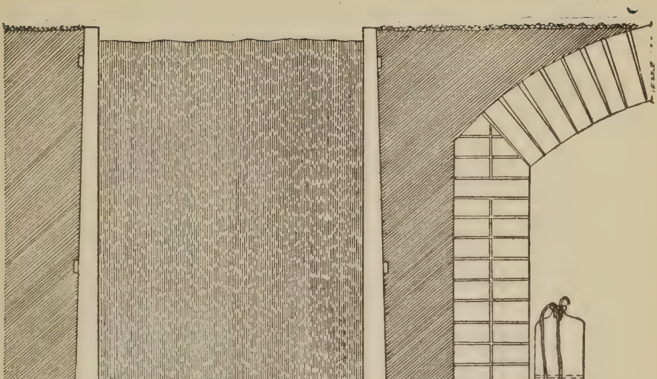
The lysimeters recently completed at the Station are four in number. Two of these contain a column of soil three feet in depth, exclusive of the sand used at the bottom; the other two contain a column six feet in depth. One of each pair was filled with the soil "in place," in order to preserve its natural composition and solidity; the other was filled with air-dried and sifted garden soil, in order to investigate the movements of soil water from a somewhat different standpoint. A sample of soil was taken from each foot in depth of the excavation in those filled "in place," and preserved for future analysis in case it should be needed. Samples of the soil with which the others were filled were also preserved.

The lysimeters were made in the form of a cylinder and bound with strong iron hoops. It was thought that this form would give greater strength and durability than the square form that has generally been employed. In order to facilitate computations, the area inclosed within the cylinders was designed to represent as nearly as possible one ten-thousandth part of an acre (28.26+ inches in diameter). The wood-work was ordered to be made so that the inside diameters of the cylinders should be 28½ inches. It was found, however, that after the copper lining had been put in, the actual diameter was a fraction less than 28¼ inches. The error was doubtless due to shrinking of the staves, which were not very dry when the cylinders were made. The desired area will be secured by soldering a copper hoop, of the exact diameter required, to the top of each cylinder.

Each lysimeter was made of 22 white oak staves of equal width. These were cut from plank 2½ inches thick, but in order to form sufficient taper to hold the hoops they were dressed down from the center to 1½ inches thick at each end. A section is shown at A A in the drawing. The bottoms were made of two inch white oak plank. In the two cylinders that were filled with surface soil, the bottom was set in a gain, cut about the inside of the cylinder, two inches from the lower end. In the other two, it was made of a diameter corresponding to that of the outside of the cylinder, as in the drawing, and was fastened in place with iron clamps, after the cylinders were filled.

The cylinders were lined with sheet copper. For the first twenty inches down from the top, the grade known in commerce as "18-ounce" (supposed to weigh 18 ounces to the square foot) was used. Below this the "14-ounce" grade was used. It was assumed that the chief danger of breakage of the lining would occur near the surface of the soil, where the changes of temperature are greatest, and where the ground freezes hardest; hence a heavier grade of copper was used in this part.

The two cylinders filled with soil "in place" were sunk about the columns of soil by excavating on the outside and dressing down the column to fit the inside of the cylinder. For the latter work, a mason's trowel was found very serviceable. In the first one filled, which was the shorter one, a cask was set on the top of the cylinder and the first soil removed was put into this, to form a weight, to assist in settling the cylinder. This, however, proved



A
A
B
C
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H

objectionable, as the adhesion of the soil to the inner wall of the cylinder became so great that it was found almost impossible to settle the latter through the last few inches of its descent. To avoid this difficulty in the longer cylinder, a hoop of bar-iron was made, of which the inside diameter was one-fourth of an inch less than that of the cylinder. This was attached to the end of the cylinder that was to enter the soil, by means of small iron brackets riveted to the hoop and fastened to the ends of the staves by strong screws. This hoop, being slightly smaller in diameter than the cylinder, regulated the size of the column of soil and prevented friction against the inner wall. It also furnished a convenient guide in dressing down the outside of the column. With this arrangement no additional weight was needed to force the cylinder down as fast as the excavation progressed.

The cylinder, having been sunk to the desired depth, was inclined to one side sufficiently to break the column of soil at the lower end, when the edge of the plank bottom was inserted into the fissure thus formed. By means of jackscrews set between the cylinder and the back of the pit, the cylinder was then crowded over upon its bottom, the latter being held in place by bracing it from the opposite bank. This accomplished, the bottom was temporarily fastened in place by screwing strong angles of band-iron to the sides of the cylinder, the lower arm of the angle being first driven beneath the bottom. A temporary head was now put on the top to keep the soil from spilling out during the removal, after which the cylinder was tipped until its top lay against the bank of the excavation. It was then lifted with jackscrews until by means of skids, a rolling chain hitch and a team, it could be rolled out of the excavation. It was next loaded upon a truck-wagon and hauled to the pit prepared for it, where it was unloaded with the end intended to enter the soil upward. The plank bottom was then removed, and six inches of the earth taken out to make room for the layer of sand, shown at B in the drawing, upon which the column of soil rests. This accomplished, the drain tube C was inserted through a hole in the side of the cylinder and securely soldered to its place. The sand, which had previously been washed and dried, was then poured in, and the top carefully leveled, after which the copper bottom D was inserted and thoroughly soldered in. The latter was ordered an inch larger in diameter than the cylinder, and its outer edge was bent into a flange half an inch wide. It was inserted with the flange pointing outward, as a boiler head is usually put in, which made it possible to nail it in securely before the soldering. The space between the copper bottom and the end of the cylinder was then filled in with a false bottom, made of half inch boards, after which the plank bottom was put on and securely fastened by means of the angle irons. The cylinder was then laid down, rolled to the pit and lowered to its position by means of an inclined plane and an extemporized windlass. The tube connecting the drain pipe with the lysimeter pit was then inserted through the wall and soldered at the point E.

The apparatus for supplying the water is somewhat different from that described in our last report, and may need some explanation. F is a graduated glass vessel holding 1,000 cubic centimeters. The bottom is stopped by a rubber cork, through which pass two slender tubes, which connect at their lower end with the four-way brass stop-cock G. Below this the tubes are continued into the mouth of the drainage tube C, which turns upward, forming an elbow inside the lysimeter pit. At H is another stop-cock, which is placed on a line with the upper side of the drainage tube C, and which, so long as it is open, limits the depth of water in the bottom of the lysimeter. It will be observed that of the two slender tubes that pass downward from the stop-cock G, the right hand one comes to an end opposite the drainage-cock H, while the other one extends somewhat farther.

Let us now suppose the water in the bottom of the lysimeter to be on a level with the open drainage-cock H, and the four-way cock G to be turned so that the holes through the pin form a passage from the reservoir F into the drainage tube C. If now there is percolation from the soil of the lysimeter, the water percolated flows out through the drainage-cock H and is collected in the bottle beneath it. If, on the other hand, the soil of the lysimeter absorbs some of the bottom water, the level of the latter falls, permitting a bubble of air to enter the slender tube at I, which, passing upward through the cock G, is conducted into the upper part of the reservoir F. This allows an equal bulk of water to pass out of the reservoir through the other slender tube into the drainage tube. Thus, whatever water passes out of the reservoir F represents the amount of bottom water absorbed by the soil of the lysimeter, and whatever flows out through the drainage-cock H represents the percolation. If the apparatus is properly adjusted, the movements of the soil water may thus be measured with a very great degree of accuracy.

When it is desired to refill the reservoir F, it is only necessary to turn the cock G one-fourth of the way around, which shuts off the connection with the drainage tube, and at the same time opens two other orifices. Water now flows through the rubber tube from the supply bottle J and rises into the reservoir, while the air escapes from the latter through the opposite end of the stopcock pin.

THE PROGRESSIVE MOVEMENT OF SOIL WATER DURING PERCOLATION.

Whether rain water, falling on a saturated soil, mingles at once with the soil water, the two flowing off together through the drainage, or whether it remains in a layer above the water already contained by the soil, forcing the latter out and taking its place, is a question of some interest to scientific agriculture. It is a well-known fact that liquids in contact tend to diffusion when not hindered by the presence of insoluble matters. For example, if we add pure water to a solution of any soluble salt, the two liquids do not remain separate, but each quickly mingles with the other, and a more dilute solution is formed.

But suppose that, before adding the water to this solution, we add to it as much of some finely divided insoluble powder as it is able thoroughly to moisten. How far, if at all, does the presence of this powder interfere with the diffusion process?

The soil is a mixture of more or less finely divided and insoluble materials, more or less completely saturated with a very dilute solution of various substances. Water falls on the surface as rain. The question raised, therefore, may be applied directly to the soil.

During the past year, a series of experiments has been conducted at this Station, intended to throw light upon this question. These experiments have gone so far that the results seem to warrant the belief that a nearly complete displacement of the water contained in a sample of saturated soil takes place, when a quantity of water is added at the surface equal to that already contained by the sample, and that diffusion takes place very slowly within the soil.

As reasons for this belief the following may be mentioned:

1. When water is added to the upper surface of a column of saturated soil, percolation commences almost immediately from the bottom, the percolation continuing as long as any water remains above the surface of the soil and no longer. In pure sand of moderate size grain, the time that elapses between the adding of the water and the commencement of the percolation is so short as to be scarcely perceptible, even when the column is of considerable length. In this case, unless the diffusion is instantaneous, a more or less complete displacement must occur.

2. A glass tube, three feet long and one and a half inches in diameter, was closed at the lower end with a bit of filter paper, which was held in place by a piece of fine wire cloth tied over the end of the tube. The tube was then filled nearly to the top with pure white quartz sand, of which the grains were something less than one hundredth of an inch in diameter. After saturating the sand with clear water, one hundred cubic centimeters of a very dilute solution of potash, colored a brilliant crimson by means of the indicator, phenolphtalein, were added at the top. The colored liquid entered the column at its upper end and passed downward rapidly, until all of it had disappeared below the top of the sand, when the downward movement suddenly ceased. The moment the colored water began to enter the sand at the top, the clear water commenced to percolate from the bottom, and as soon as the former ceased to move downward, the percolation came to an end. One hundred cubic centimeters of clear water were next added, when the colored liquid at the top of the column moved downward, being followed by the clear water, until the water had all entered the sand, when the movement again stopped. Next, the colored liquid was again added with the result noted at first. The liquids were alternated in this way until the column was filled throughout with the red and white bands formed by the differently colored liquids. The boundaries of these bands were not very sharply defined, though by no means obscure. After this, the column was left undisturbed for three days, and at the end of this time the bands

were still visible, though rendered rather indistinct through diffusion.

The fact that these colored bands moved successively downward through the sand is clear evidence that the added liquids displaced the liquids already contained by the sand, and that diffusion did not take place during the process to any great extent.

3. In another experiment a glass cylinder eighteen inches long and five inches in diameter, closed at its lower end as already described, had its inner walls dusted with a little of the indicator named above, after which it was filled with emery flour and the latter saturated with water. A little dilute solution of potash was then added at the upper end of the cylinder. The crimson color produced by the action of the potash on the indicator first appeared at the top, and passed downward regularly, as long as any of the solution remained above the emery. When the latter had all disappeared, however, the downward movement ceased until more was added. This process continued until the bottom of the cylinder was reached by the colored band, but not a drop of the colored liquid passed off, as percolation, previous to this time. The amount of the percolation before the potash appeared was somewhat greater in this case than the amount of water contained by the emery flour, showing clearly that the potash solution did not come through until it had first forced out the water contained by the emery flour.

4. Other tests were made, using nitrate of soda, sulphate of copper and common salt, adding dilute solutions of these substances to columns of sand and detecting their appearance in the percolation by means of indicators, with similar results.

5. In a later experiment, the attempt was made to measure the actual per cent of displacement in the case of the white sand used in the trial first described. The wet sand in the tube was replaced by dry, and just beneath the center of the bottom of the tube, was secured a piece of filter paper, upon which was placed a bit of the indicator named above. A measured quantity of water was then added at the top of the tube, and after the percolation had ceased, the quantity percolated was measured, to ascertain the amount of water retained by the sand. The same quantity of a one per cent solution of potash was next added by means of a

supply bottle so arranged that the solution came in contact with the sand as fast as the latter would absorb it, but no faster. Thus the indicator at the bottom of the tube would reveal the first molecule of potash that had passed through the sand, and by means of a screw-clamp the supply of the solution from the bottle could be instantly stopped. Four trials made with this apparatus showed the average percentage of the water displaced by the solution, before any of the latter had passed through the sand, to be 93.65.

Many attempts were made to measure the percentage of displacement in samples of ordinary garden soil, but every one failed from the fact that some quality of the soil either destroyed the virtue of the indicator used, or else fixed the material used in the solution. Several trials were, however, carried out with emery flour with partial success. With this material, the downward progress of the potash solution used was readily traced by dusting the indicator along the inside of the cylinder, as already described. The movement was always progressive, but the solution did not appear to travel as rapidly as the amount added, and the amount of percolation would indicate. The emery flour either removed a part of the potash from the solution, or else fixed a portion of it. In none of the trials, however, have any results been secured that were opposed to an hypothesis of the progressive movement of the soil water.

Experiments are needed to discover the influence of the size of the particles, the depth of the column, the rate of water supply, etc., upon the percentage of displacement.

EXPERIMENTS ON CAPILLARY ACTION IN SOILS.

The height to which water rises by capillarity in different soils, and its rate of progress.

The influence of matters in solution upon the rate of capillary flow.

THE HEIGHT TO WHICH WATER RISES BY CAPILLARITY IN DIFFERENT SOILS, AND ITS RATE OF PROGRESS.

Under this subject, is described in our Report for 1887 (pp. 103–4), an apparatus designed for measuring the extent and rate of the rise of water through different soils by capillary attraction.

This apparatus consists of four vertical glass tubes, five feet in length and about one and five-eighths inches inside diameter, supported in a vertical position, with their lower ends covered with fine brass wire cloth, and connected with a pan, in which water is kept at a very nearly constant depth by means of an inverted supply bottle. One of these tubes was filled with muck, a second with garden soil, a third with sand and the fourth with clay, all of the soils being air-dry, and sifted through a sieve of 100 meshes to the inch.

This experiment was started May 5, 1887, and has been since continued. The rise of the water by capillary attraction as determined by the change in color of the soil, was measured daily during the first eight months. After this, as the rate became very slow, the measurements were made less frequently. In our last report the rise of water in the different tubes is given from May 5 to November 17, 1887.

During the past year the water has continued to advance slowly in all of the tubes, and in the one containing the garden soil, the water had risen to the top of the column by August 15. It is interesting to notice, however, that the comparative rate of progress in the muck and garden soil was reversed during the last few months. Thus the water rose in the garden soil only 5¾ inches from November 17, 1887, to August 15, 1888, while in the muck it rose 10¾ inches in the same time. The height to which the water had risen in the different tubes on November 17, 1887, and on August 15 and November 17, 1888, was as follows:

	TUBE NO. 1, MUCK.		NO. 2, GARDEN SOIL.		NO. 3, SAND.		NO. 4, CLAY.	
	Height of water.	Progress.	Height of water.	Progress.	Height of water.	Progress.	Height of water.	Progress.
	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
November 17, 1887	23¼	......	48	......	20¼	......	34	......
August 15, 1888	33⅞	10¾	53¾	5¾	24	4¾	35	1
November 17, 1888	36⅛	2¼	......	......	24½	½	35½	½

At the time this experiment was started, it was thought that it would give some indication of the power of the different soils, in their natural condition, to transmit water by capillary attraction.

It probably does not do this unless it be in the case of the sand. In the garden soil and clay, the angular particles of the air-dry material are probably in contact only at their corners, while in the muck the expansion of the material due to the absorption of water is so great that the particles are doubtless so closely pressed together as to materially retard the passage of water through and between them.

THE INFLUENCE OF MATTERS IN SOLUTION UPON THE RATE OF CAPILLARY FLOW.

In an experiment reported in 1887,* it was shown that weak solutions of sodium chloride promoted the rate of capillary flow in horizontal tubes filled with sifted garden soil, while stronger solutions retarded it. This experiment was repeated with sodium nitrate with the same result, *i. e.*, a five per cent solution promoted the rate, while a ten per cent solution retarded it. The attempt was made to repeat the experiment with solutions of muriate of potash, but the apparatus becoming broken, it had to be abandoned.

Von Klenze,† who made experiments with weak solutions of various soluble salts in vertical tubes, found that all the solutions rose slower than distilled water, and that the retardation increased with the strength of the solution. The results secured in my experiments strongly suggest that a somewhat different law applies in horizontal tubes.

THE CONDENSATION OF WATER AT THE SURFACE OF THE SOIL DURING COLD NIGHTS IN SPRING.

Every gardener knows that his partially dry surface soil is rendered temporarily wetter by freezing and thawing. It often happens in early spring that the soil is in excellent condition for planting at night, when on the following morning, after a clear, cold night, in which the surface freezes somewhat, it is so wet and sticky on thawing out that work upon it has to be deferred. In order to ascertain if the amount of this condensation is as great as it appears to be, two samples of soil were taken from the surface of a garden bed at 6 P. M. on April 23, and two others on the following morning. These were dried, from which it appeared that those taken at night contained on the average 7.57 per cent of water, while those taken in the morning contained 10.06 per cent. The samples were taken to the depth of about three-fourths of an inch, and the figures indicate that, to at least this depth, the soil gained in moisture content 2.49 per cent during the night. It appears, therefore, that the amount of water thus condensed is really small. If we assume that the soil increased at the same rate to the depth of two inches, the increase would only amount to about one-fortieth of an inch of rain.

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* Report New York Agricultural Experiment Station, 1887, pp. 109-10.

† Landwirthschafliche Jahrbücher, Band VI, Heft 1, pp. 109-10.

THE HEIGHT OF WATER IN WELLS.

The observations upon the depth of the water table, as indicated by the height of water in an abandoned well near the Station buildings, which were commenced in December, 1886, have been continued daily throughout the past year. The results are of considerable interest, as they indicate that the depth of the water table is influenced far more by season than by the amount of rainfall. The height of the water in the well on the first day of each month, and also the rainfall for the month immediately preceding, for two years, is here given, and in order to make the figures more readily intelligible, the results are also presented in graphic form :

	1887.			1888.		
	Distance to water.		Rainfall of preceding month.	Distance to water.		Rainfall of preceding month.
	Ft.	In.	In.	Ft.	In.	In.
Dec. 1 (1886 and 1887)	13	2.	3.48	16	9.	1.58
Jan. 1	6	4.	1.24	17	3.5	1.34
Feb. 1	5	8.	.18	15	3.25	.78
March 1	4	10.25	2.97	9	11.75	1.04
April 1	5	.75	.48	5	1.75	1.43
May 1	4	2.25	1.37	4	8.	3.09
June 1	6	10.	.46	6	2.75	2.79
July 1	9	2.	2.01	7	10.25	3.88
Aug. 1	10	5.75	6.37	9	2.5	.99
Sept. 1	11	3.	3.03	11	7.5	4.02
Oct. 1	13	4.5	.75	13	9.25	2.73
Nov. 1	15	4.5	1.74	14	4.	3.46

In the graphic diagram, each mark in the water table record indicates one foot, measured from the top of the diagram, and in the record of precipitation, each mark represents one-fifth of an inch, measured from the bottom. Although the record is much shorter than is desirable for the purpose of forming conclusions, two facts are strikingly brought out.

1. Fluctuations in the precipitation from month to month did not much affect the height of the water table. The very light precipitation of January, 1887, did not stop the rise of the water table, nor did the extremely large rainfall of July of the same year cause the water table to stop falling.

2. The rapid rise in the water table from January 7 to April 1, 1888, was not due to large precipitation during this time, nor was the fall from May 7 to November 1, of the same year due to small precipitation.

These facts suggest that a study of the relation of the height of the water table to the amount of rainfall may develop some interesting, if not valuable knowledge.

THE SOIL HYGROMETER.*

The experiments with this instrument were continued so far as was possible with home made apparatus. Owing to imperfections in this, no record of scientific value can be presented. The experiments of the past season, however, added strength to the probability that the principle adopted is capable of furnishing an accurate record of the fluctuations in the moisture of the soil.

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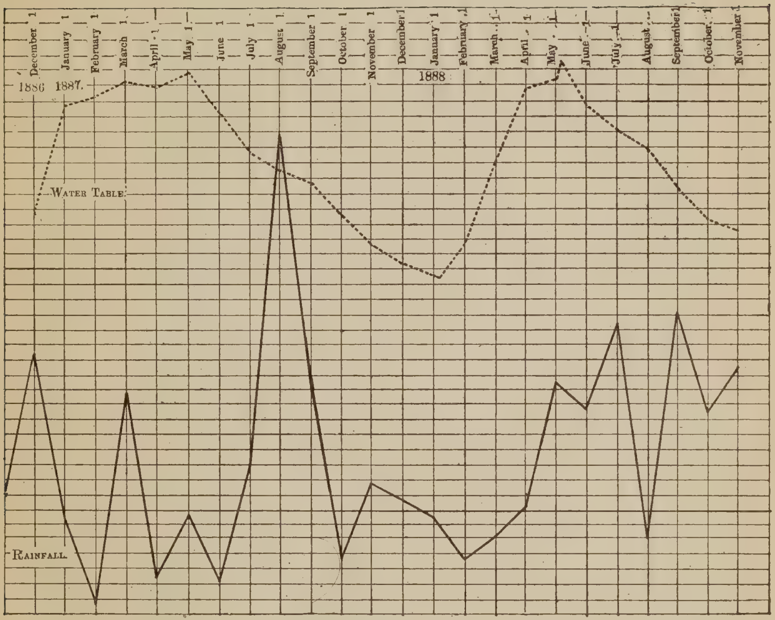
*For description and illustrations of the soil hygrometer see Reports New York Agricultural Experiment Station for 1886, p. 182; 1887, pp. 1


December 1
January 1
February 1
March 1
April 1
May 1
June 1
July 1
August 1
September 1
October 1
November 1
December 1
January 1
February 1
March 1
April 1
May 1
June 1
July 1
August
September 1
October 1
November 1
1886
1887.
1888
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Rainfall.

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OF THE

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NOTE.—The references to the Reports for 1885 and 1886 refer to the edition published by this Station, and not to the one published by the State Legislature.

The matter contained in the present Report (1888) could not be included in this index. It is, however, indexed at the end of this volume.

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REPORT OF ASSISTANT HORTICULTURIST.*

The present report covers the eight months of 1888 from January to August, inclusive. Only that part of my work in the fruit and vegetable garden which was completed, *i. e.*, that relating to strawberries and raspberries, is included in my report. A few observations have been extended beyond this time and completed through the kindness of Mr. E. S. Goff, the horticulturist to the Station. The study of the potato scab has been continued the present season. No positive conclusions have been reached in regard to the cause of the disease or a remedy for the same, yet the knowledge obtained will be useful in planning for future experiments.

IS SCAB PRODUCED BY FERTILIZERS?

An experiment was conducted in eight-inch pots in the greenhouse. Medium-sized tubers of the White Star variety were planted in pots filled with sand that was free from organic substances. They were fertilized with chemicals so as to provide for some an excess of certain different constituents of plant food, such as nitrogen, potash and phosphoric acid. The results obtained were such that no conclusion could be drawn from them.

PREVENTIVES OF SCAB.

A test similar to that made last season,† of substances to prevent the scab, was made in the garden. The different substances used and the method of treatment were as follows:

1. Sulphide of potassium, one-fourth ounce dissolved in four quarts of water.
2. Sulphate of iron, one ounce dissolved in one quart of water.
3. Sulphate of copper, one-half ounce dissolved in one quart of water.
4. Sulphur, cuttings moistened and then rolled in the sulphur.
5. Sawdust, a large handful dropped upon each cutting before covering with soil.

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* M. H. Beckwith.

† Report for 1887, p 313.

6. Coal ashes, a large handful dropped upon each cutting before covering with soil.

7. Chloride of sodium (common salt), one-fourth ounce in each hill.

8. Wheat bran, a large handful in each hill.

9. Ground bone, a large handful in each hill.

10. Nitrate of soda, one-half ounce dropped in each hill before covering.

11. Ground bone, one-fourth the quantity used in No. 9.

12. Sulphate of potash, one-half ounce in each hill.

When the substance used was dissolved in water the whole tubers were placed in the solution and allowed to remain twenty hours, then cut into halves lengthwise and immediately planted. One row was left untreated for comparison.

Tubers of the White Star variety were used for seed in this planting. The rows were three and one-half feet apart, and the pieces were placed two feet apart in the rows and ordinary cultivation was given the entire plat.

In the following table the data of the yield of each row is given as follows: The total number of tubers, per cent of yield scabby, number free from scab, slightly and badly scabbed, total number scabby:

Number.	TREATMENT.	Total number of tubers.	Per cent of yield scabby.	Number free from scab.	Number slightly scabby.	Number badly scabbed.	Total number scabby.
1	Sulphide potassium	186	27	136	42	8	50
2	Sulphate of iron	162	24	123	32	7	39
3	Sulphate of copper	65	14	56	7	2	9
4	Flowers of sulphur	152	18	124	22	6	28
5	Sawdust	190	60	76	54	60	114
6	Coal ashes	178	18	145	26	7	33
7	Chloride sodium (common salt)	131	33	88	36	7	43
8	Wheat bran	150	61	59	54	37	91
9	Ground bone	160	56	71	71	18	89
10	Nitrate soda	134	48	70	58	6	64
11	Ground bone	225	49	115	87	23	110
12	Sulphate potash	136	43	83	57	6	63
13	Untreated	179	44	101	62	16	78

The results obtained are somewhat surprising, and much at variance with results reported by others. The treatment of sawdust and wheat bran, that has been so confidently recommended, proved injurious rather than beneficial, sixty and sixty-one per cent, respectively, of the yield of those rows being scabby, while the treatment with coal ashes, that is claimed to be favorable to the production of scab, was equally as efficacious as the sulphur, each row producing 18 per cent of the yield that were scabby.

The row treated with sulphate of copper gave the smallest per cent of scabby tubers. This treatment appeared to be the most beneficial of any last season,* while the ground bone again was detrimental.

From the results obtained it is evident that little is known concerning the true cause of, or remedy for, this disease. A Norwegian botanist claims to have found a slime fungus upon the diseased tubers, to which he ascribes the formation of the scab.

IS THE POTATO SCAB CAUSED BY INSECTS?

For the purpose of securing some reliable data upon this subject, several hundred hills of potatoes, in various stages of growth, were carefully examined for evidence showing that the scab was due to injuries caused by insects feeding upon the tubers. Nothing of the kind was found, though millipedes were frequently found working in the decaying seed tuber.

Doubtless the injuries to the tubers caused by insects or their larvæ feeding upon them are often mistaken for the scab, as the corky formation that frequently covers the wound appears very similar to scab. A careful examination of the two will, in most instances, disclose a difference in appearance, the true scab spreading more upon the surface of the tubers, while that from insect injuries is generally limited to a deeper cavity, the edges of which end more abruptly.

On February 14, an experiment was begun in the following manner: A glass vessel was partially filled with soil that had been passed through a fine sieve, and several dozen millipedes (Julus) were placed therein together with several potato tubers, one of which had the skin removed from one end so that the inner part was exposed. One tuber had received an injury in digging, the tine of the digging fork having penetrated it to the depth of about one inch.

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*Report for 1887, page 313.

Especial care was taken to cover the vessel to prevent the escape of the millipedes. The vessel was placed in the office connected with the green-house, where the temperature was usually from 60° to 70° F. The tubers were examined February 20, and it was found that the millipedes had removed all the dirt and decayed substance from the place where the fork had penetrated and the wound had begun to callous over. Otherwise the tubers gave no evidence of their feeding upon them, although they were burrowing underneath the tubers and through the soil.

A partially decayed tuber was at this time placed in the vessel with the others. February 25 the millipedes were busy feeding upon the decayed portion of the tuber, but had not fed upon the sound ones. Frequent examinations of the tubers were made until April 10, with no indication that the millipedes had fed upon the sound tubers. After entirely removing the decayed portion of the tuber they left it and burrowed into the soil.

Later in the season two potato plants upon which tubers were beginning to form were transplanted into glass vessels containing sand that had been thoroughly washed to remove all organic matter. In each vessel were placed 50 millipedes. Nothing could be found to indicate that they had fed upon the tubers when they were examined thirty days later.

Insects will often feed upon that which is not their natural food when nothing else is accessible and in this instance it would not have been surprising had the millipedes fed upon the sound tubers.

Hence, it is but reasonable to draw the following conclusions:

1. Millipedes do not feed upon the sound tubers of the potato.
2. Their food consists of decaying vegetable matter.
3. The presence of millipedes in the hills with the scabby tubers was due to the scab, they being attracted by the decayed portion which they desired for food, and the scab is not due to their presence.

SMOOTH VERSUS KNOBBY SEED TUBERS.

To determine whether by using smooth tubers for seed a larger proportion of the yield would be smooth tubers than by using knobby seed tubers, three plats of one-twentieth of an acre each were planted May 7 with smooth and knobby tubers in alternate rows. The tubers were cut lengthwise into two pieces. One piece was planted every two feet in rows three and one-half feet apart. Ordinary cultivation was given the plats. In selecting the seed the smoothest and knobbiest tubers were selected; consequently the smooth tubers were of medium size, while the knobby tubers were very large.

When the crop was harvested, the following, data were obtained: The yields of the rows planted with smooth seed amounted to 521¼ pounds, and of those planted with knobby seed 649¼ pounds. This shows a very striking difference in yield in favor of the knobby seed. It is interesting to note that the larger yield was from the larger seed tubers.

The rows planted with smooth seed had 121 knobby tubers; those planted with knobby seed had 184 knobby tubers; which shows that for every 100 pounds of yield from the rows planted with smooth seed there were 23.20 knobby tubers, while from those planted with knobby seed there were 28.34 knobby tubers to the 100 pounds. The influence of the seed is quite strikingly shown in this instance, yet it is hardly safe to draw a conclusion until further data are obtained.

In planning this experiment it was intended to be continued through a number of years, selecting each year the smooth tubers from the rows planted with smooth seed and the knobby tubers from those planted with knobby seed, for planting the following season. In this manner reliable data could be obtained and settle the question.

A TEST OF INSECTICIDES.

For the purpose of determining the comparative value of Paris green, London purple and Zoektein in destroying the larvæ of the potato beetle, *Doryphora* 10-*lineata* Say, the rows planted with the different varieties of potatoes were divided into six equal parts. Each part being fifteen feet wide and extending across the rows of all the varieties, was treated with an insecticide as follows:

1. London purple, one part to 150 parts of land plaster.
2. London purple, one ounce to ten gallons of water.
3. Paris green, same proportion as No. 1.
4. Paris green, same proportion as No. 2.
5. Zoektein powder, same proportion as No. 1.
6. Zoektein paste, same proportion as No. 2.

The poison was thoroughly mixed with the land plaster in each instance and applied to the tops of the potatoes by means of an arrangement for that purpose, consisting of a tin vessel with perforated bottom.

The liquid was applied with an ordinary sprinkling pot. No difference in the effectiveness of the different treatments could be observed, as nearly all the larvæ on each strip treated were destroyed. The solution of Zoektein paste and water was applied too strong, as the foliage was injured somewhat, and a weaker solution proves to be just as effective in destroying the larvæ. The Zoektein is very much cheaper than either Paris green or London purple. It will undoubtedly prove a valuable insecticide and be introduced into general use.

ANOTHER INSECT PEST.

In the early part of June, Mr. T. C. Maxwell, of the firm of T. C. Maxwell & Bros., Geneva, N. Y., informed me that the new growth of the quince and plum trees in their orchards had the appearance of being blighted, which appeared to be caused by the larva of some insect. Some specimens of the infested twigs were obtained, and a small worm was found burrowing in the twig, which in every instance had entered the twig at a bud in the axil of a leaf. Specimens of infested twigs were sent to Dr. J. A. Lintner, State Entomologist. A specimen of a moth, which I succeeded in rearing from the larva in the infested twigs was also forwarded to him, on August 6, for identification. The following communication was received from Dr. Lintner in reference to the insect: "I do not recognize the moth; it is probably one that I have never met with. I will endeavor, later, to determine it, as it will probably prove an addition to our lists of insect depredators preying upon the fruits."

The ravages of this insect could doubtless be greatly lessened by spraying the trees after the new growth has started in the spring, with Paris green or London purple.

STRAWBERRY.

A test of varieties.

The varieties of strawberries in the following list have been in bearing for three seasons, having been planted in the spring of 1885, this being the third* crop the beds have produced.

The data noted in the table are the first bloom, first and last ripe fruit, number of days in bearing, the yield in ounces for fifty feet in length of matted row, and for twenty-five plants or fifty feet of row grown in hills; also the average number of berries per ounce from each row. The yield in each instance is computed from the berries picked from the whole number of plants in the row, which was usually from 15 to 20. The plants grown in hills and the runners kept cut off were two feet apart in the rows; the matted rows were from three to five feet in width according to the variety.

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* The data of the first and second crops are given in the reports for 1886 and 1887, pp. 253 and 334, respectively.

STRAWBERRY.

VARIETY.	First bloom.	First berries ripe.	Last berries ripe.	Number of days in bearing.	Ounces of berries from matted row.	Ounces of berries from row in hills.	Average number berries per ounce in matted row.	Average number berries per ounce in hill row.
Bidwell	May 19	June 25	July 11	16	137½	31¼	14.3	10.
Chas. Downing	19	25	12	17	491¼	52	14.9	10.4
Cornelia	29	25	14	19	274⅜	24½	9.4	15.3
Covill's Early	15	14	June 29	15	212¼	......	14.2	......
Daisy Miller	22	23	July 11	18	492¼	37⅛	9.4	16.8
Excelsior	24	23	12	19	286½	......	10.5	......
Garretson	15	16	14	28	187½	54⅛	14.2	13.4
James Vick	21	23	11	18	492½	71¼	9.9	14.9
Jersey Queen	24	25	13	18	235	21⅝	12.2	12.3
Jucunda	19	21	2	11	58¾	16¾	13.2	20.8
Jumbo	19	20	11	21	506¼	131¼	5.3	9.6
Kentucky	23	25	14	19	603⅛	103	10.4	8.2
Legal Tender	25	25	13	18	481¼	32	7.4	9.3
Lennig's White	14	19	13	24	81¼	31¼	9.7	7.2
Longfellow	22	25	14	19	363¾	50	8.7	7.2
Manchester	23	25	14	19	635⅝	161⅛	9.2	7.4
Manchester (duplicate)	21	25	14	19	436⅞	118¼	9.6	8.8
May King	15	23	16	18	288¾	30	11.6	12.2
Mount Vernon	19	25	16	21	695	83¼	14.3	14.4
Mrs. Garfield	11	20	12	22	335	102¼	10.6	9.2
Ontario	23	25	9	14	......	33⅜	.....	7.3
Parry	19	23	14	21	388¾	55⅛	10.9	6.5
Piper's Seedling	16	24	11	17	280⅝	59	8.8	13.7
Primo	21	25	11	16	698⅛	71	8.	9.1
Prince of Berries	24	25	16	21	320⅝	84½	11.1	10.7
Sharpless	23	25	12	17	284¾	18⅞	7.7	8.
Wilson	9	18	9	21	253¾	68½	12.6	13.3
Woodruff No. 1	14	25	14	19	581	97¾	9.4	12.
J'nson's unnam'd seedl'g	29	July 2	....	....	......	......	.....	......

Ripe berries were picked from Covill's Early on June fourteenth, two days earlier than from any other variety.

The latest first ripe berries from any variety was obtained from the unnamed seedling received from R. S. Johnson, which was on July second. The berries of this variety have a most delicious flavor; but the flesh is too soft to be of value.

The Garretson and Lennig's White remained in bearing the greatest and the Jucunda the least number of days.

The largest yield from matted row was obtained from the Primo and Manchester.

The Manchester gave the largest yield of any variety grown in hills.

The Jumbo averaged the largest berries of any variety grown in matted row, and Charles Downing the smallest.

The Parry averaged the largest berries of any grown in hills, the smallest was Daisy Miller.

The matted rows yielded the greatest quantity of fruit in every instance.

There is no doubt but that the matted row system of growing strawberries is the most profitable method of culture, especially so where the plants are not allowed to grow too thick in the row.

RASPBERRY.

Nearly all the varieties of raspberries in the following list were reported on last year.*

This season each variety was grown in hills; four to six canes were allowed to grow in each hill; all suckers in the rows were treated as weeds and not permitted to grow. The yields of fruit as given in the table is that picked from six hills of each variety. The dates of first bloom, first ripe berries, first and last pickings of berries, the weight of fruit in ounces, average number of berries per ounce and number of days each was in bearing, are given in the table.

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* Report for 1887, p. 336.

RASPBERRY.

VARIETY.	First bloom.	First ripe fruit.	First picking.	Last picking.	Weight in ounces.	Average number of berries per ounce.	Days in bearing.
Brandywine	June 18	July 18	July 20	Aug. 13	45	22	24
Caroline	11	10	13	14	248	21	30
Crimson Beauty	16	16	18	11	22	30	24
Cuthbert	17	16	18	11	144	18	24
Erie	11	9	11	7	68	32	27
Gregg	15	16	16	4	109	23	19
Hansell	11	9	11	9	71	24	29
Johnson's Sweet	12	12	14	July 28	106	36	14
Lost Rubies	16	21	23	Aug. 11	30	23	19
Mammoth Cluster	13	16	16	4	137	32	19
Marlboro	11	9	11	13	128	20	33
Meredith Queen	16	20	21	13	49	28	23
Miller's Woodland	12	12	18	9	46	21	22
Montclair	11	9	11	13	107	22	33
Naomi	14	13	13	4	114	27	22
Ohio	11	14	14	1	113	36	18
Orange	11	9	11	7	50	17	27
Philadelphia	11	14	16	9	75	27	24
Reder	16	9	11	11	161	19	13
Schaffer	19	23	27	11	134	13	15
Silver Queen	16	14	16	7	37	21	22
Souhegan	11	17	18	1	204	27	14
Superb	12	16	16	11	59	22	26
Turner	16	11	13	7	78	24	25
Seedling, Carpenter's	11	11	11	7	90	23	27
Seedling, White	11	9	11	1	116	31	21

It appears that the Caroline was the most productive variety and continued in bearing thirty days. The Crimson Beauty was the least productive.

The Marlboro and Montclair continued in bearing the greatest number of days, three days longer than Caroline.

The Schaffer produced the largest berries, the average number to the ounce being seventeen; the Ohio the smallest, averaging thirty-six berries to the ounce.

Cross-Fertilization of Fruits and Vegetables.

There is a broad field for valuable work in the breeding of new varieties of fruits and vegetables by the systematic artificial crossing of different varieties. It is a work that requires skillful manipulation, a large amount of persistent labor and large stock of patience. One's whole attention might be profitably devoted to this work; beginning with the earliest varieties that blossom in the spring, continuing it through the season until the latest blossoms are gone. As the fruit of the different crosses ripened, planting of the seed should be made, the plants from which would necessitate constant attention the remainder of the growing season.

Seeds were obtained the past season from the Thimbleberry *(Rubus odorata)*, fertilized with pollen of the blackberry and also the raspberry. Several plants grown from seed of the Gregg raspberry, fertilized with pollen of the Red and also of the Yellow Antwerp raspberry, produced fruit this season. While none of the plants produced fruit that gave indications that it would prove valuable, the result was very interesting. Several plants were very similar in appearance and habit of growth to the Caroline, producing fruit in great abundance, the berries greatly resembling those of the Schaffer.

REPORT OF THE CHEMIST.*

In this report, as in previous ones, considerable attention has been given to fodder analyses; but the amount of routine work has made it impossible for us to make the analyses so complete as we deem desirable. With our present knowledge of the value of feeding-stuffs, an analysis of a food can not be said to be complete which fails to determine the albuminoid and non-albuminoid nitrogen, also the sugars and starch of the nitrogen-free extract.

Ash analyses have been made for a considerable number of our feeding-stuffs, so far as the fertilizing elements are concerned. In this report the questions discussed are:

1. Composition of feeding-stuffs.
2. Amount of fertility removed from the soil by crops.
3. Influence of fertilizers on the chemical composition of grass.
4. Influence of fertilizers on the chemical composition of oats.
5. Chemical composition of hays from different localities.
6. Changes in corn as it approaches maturity.

During the winter of 1887–8 the feeding experiments were placed under my supervision, and the result of the several trials are given under the following heads:

1. Digestion experiments with orchard grass.
2. Digestion experiments with a ration.
3. Influence of certain rations on the milk product.
4. Influence of food on the chemical composition of butter.
5. Fattening experiments with young cattle.
6. Ensilage vs. corn fodder for feeding.
7. Feeding for fat and for lean meat.

The success of these experiments is due largely to Mr. Emery and Mr. Churchill, whose coöperation made possible the trials. Of necessity the amount of chemical work connected with such experiments was large, and I am indebted to Mr. Wheeler for the aid necessary to carry through these experiments.

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*E. F. Ladd.

The number of water analyses during the past year was very large, monthly determinations having been made of the drainage from the lysimeters, also from Castle brook and the main drain from the experimental plats. Of well waters 25 samples have been examined and reported upon; also analysis was made of water from one mineral spring, but as none of these are of general interest, except to the parties interested, they are not reported in these pages.

Of fertilizer and fertilizing ingredients 36 samples have been analyzed during the year, while many as yet remain on hand, our present laboratory force and crowded accommodations making it impossible for us to do the amount of work desired. In fact I may say that the work of the chemical department has increased to such an extent as to make it impossible to longer carry on the work successfully in our present overcrowded quarters, a single room in a former dwelling-house, with no proper means of ventilation or ridding the room of obnoxious fumes and gases; nor can there be the proper appliances in a room of this kind for conducting investigations with the present needs of the Station. In the report of Mr. Wheeler will also be found the results of other chemical work connected with the subjects specially investigated by him.

FODDER ANALYSES.

In the analysis of foods the chemist separates each food into several parts, to each of which he gives separate names, such as ash, albuminoids, water, etc., according as they fulfill certain functions in plant and animal growth. We give, substantially as printed in the last report, the terms in use:

Water.—The loss in weight of a fodder by drying, usually at 100° to 110° C. (212° to 230° F.), is due to the moisture or water which the fodder contains.

Ash.—That part of the fodder which remains after burning constitutes the ash or mineral matter. The ash ingredients form the solid matter of the animal frame-work — bones — and occur also in small quantities in the muscles, blood, etc. Lime, phosphoric acid, potash, etc., constitute the mineral elements of the ash.

Albuminoids.— The albuminoids are the principal nitrogenous portion of fodders — the muscle-formers — sometimes also called protein. The albuminoids are not known to be definite compounds, but are made up of a large number of nitrogenous products, which have usually been classed alike for feeding purposes. The white of an egg, the tenacious mass — gluten — which remains on washing the dough from wheat flour, and animal muscles are common examples.

Not all of the nitrogenous matter of feeding stuffs is in the form of albuminoids, but often a considerable portion is in what may be termed a transitory state known by the general name amides. Amides have a less nutritive value than the true albuminoids. However, they probably have a greater nutritive value than many experimenters have assigned to them.

Crude fiber is the woody portion — frame-work — of vegetable matter which is unacted upon by dilute acids or alkalies. Crude fiber has little *direct* nutritive value to the animal.

Nitrogen-free extract.— This is a mixture of various substances which are sometimes called carbo-hydrates. The starches, sugars, dextrine, pectic and mucilaginous bodies, gums, etc., are the principal substances of this class.

Fat.— The other extract of feeding stuffs is a mixture of oils, wax, coloring matter, etc. Cotton-seed oil, linseed oil, corn oil, etc., are common examples.

ANALYSES OF FODDERS.

During the past year, a large number of fodder analyses have been made. A large part of these analyses are given under their appropriate heads, but there remain some of a miscellaneous nature grouped under the above head which do not appear in full elsewhere. Besides the regular analyses, there have been made determinations of the albuminoid and non-albuminoid nitrogen, the digestibility of the albuminoids and in some cases ash analyses for the fertilizing ingredients.

Unless otherwise stated, the grasses were all cut in full bloom.

Laboratory number.	GRASSES, ETC.	FRESH SUBSTANCE.						DRY SUBSTANCE.				
		Water.	Ash.	Albuminoids, N × 6.25.	Crude fiber.	Nitrogen-free extract.	Fat (ether extr't).	Ash.	Albuminoids, N × 6.25.	Crude fiber.	Nitrogen-free extract.	Fat (ether extract).
2,357.......	Meadow foxtail..................	72.63	1.71	3.12	8.66	12.72	1.16	6.21	11.37	31.66	46.52	4.24
2,365.......	Orchard grass.....................	70.90	2.11	2.76	10.14	12.87	1.22	7.27	9.50	34.86	44.17	4.20
2,366.......	Tall meadow oat..................	68.95	1.90	2.35	10.78	15.01	1.01	6.12	7.56	34.68	48.40	3.24
2,367.......	Kentucky blue.....................	58.76	2.03	3.18	13.29	21.27	1.47	4.92	7.71	32.24	51.55	3.58
A.	Timothy (average 9)..............	67.09	1.41	2.50	11.54	16.36	1.10	4.28	7.60	35.06	49.71	3.35
B.	Ray grass (average 24)...........	73.16	2.46	3.06	6.72	13.27	1.33	9.19	11.39	25.09	49.38	4.95
2,388.......	Alsike clover......................	72.26	2.09	4.23	9.35	11.22	.85	7.52	15.25	33.73	40.43	3.07
2,394.......	Alsike clover......................	74.53	1.88	3.93	7.49	11.53	.64	7.37	15.44	29.42	45.26	2.51
	GREEN FODDERS.											
C.	Prickly comfrey....................	88.24	1.64	1.88	2.66	5.27	.31	13.93	16.00	22.66	44.76	2.65
2,114.......	Ensilage (maize)..................	80.50	1.26	1.62	3.63	12.45	.54	6.47	8.31	18.69	63.76	2.77
2,455.......	Maize fodder......................	80.24	.85	2.07	5.69	10.56	.59	4.32	10.50	28.83	53.86	2.49
	HAYS.											
2,026.......	Timothy A..........................	......	....	......	......	......	....	3.47	8.00	40.27	46.23	2.03
2,027.......	Timothy B..........................	......	....	......	......	......	....	4.17	8.00	40.09	45.31	2.43
2,040.......	Hay, mixed........................	15.41	5.26	7.56	29.91	39.02	2.84	6.22	8.94	35.36	46.12	3.36
2,045.......	Orchard grass.....................	13.64	5.63	8.31	36.18	32.92	3.32	6.52	9.62	41.97	38.04	3.85
2,088.......	Orchard grass.....................	12.50	5.37	8.42	32.08	38.43	3.20	6.14	9.62	36.66	43.92	3.66
2,209.......	Timothy............................	......	....	......	......	......	....	6.76	7.25	35.66	47.14	3.19

Laboratory number.	GRASSES, ETC.	Fresh Substance.						Dry Substance.				
		Water.	Ash.	Albuminoids, N × 6.25.	Crude fiber.	Nitrogen-free extract.	Fat (ether extr't).	Ash.	Albuminoids, N × 6.25.	Crude fiber.	Nitrogen-free extract).	Fat (ether extract.
2,222	Timothy	......	....	......	......	.....	....	5.10	8.62	33.92	49.34	3.02
2,223	Timothy (past bloom)	......	....	......	......	......	....	5.39	7.69	33.74	50.07	3.11
2,235	Hay (mixed)	14.95	4.97	6.38	27.55	43.65	2.50	5.83	7.50	32.39	51.33	2.95
2,286	Hay (damaged)	......	....	......	......	......	....	6.25	7.68	34.18	49.09	2.80
	STRAW.											
2,034	Oat straw	18.27	5.66	3.78	34.77	35.37	2.15	6.93	4.62	42.54	43.28	2.63
2,113	Maize stover (stalks)	22.63	5.35	6.47	28.43	35.87	1.25	6.92	8.37	36.75	46.34	1.62
	GRAINS AND MEALS.											
2,112	Corn meal	19.08	1.12	9.51	1.47	65.12	3.70	1.39	11.75	1.83	80.46	4.57
2,441	Oats, A	11.11	2.81	14.44	12.40	54.28	4.96	3.16	16.25	13.95	61.06	5.58
2,442	Oats, B	11.86	2.81	13.44	11.50	55.03	5.36	3.19	15.25	13.05	62.43	6.08
2,443	Oats, D	12.07	2.89	13.41	12.76	53.53	5.34	3.29	15.25	14.51	60.87	6.08
2,444	Oats, E	11.36	3.22	11.19	12.76	55.88	5.59	3.63	13.75	14.40	61.91	6.31
	BY PRODUCTS.											
2,032	Linseed meal	10.56	4.59	35.94	11.89	28.38	8.64	5.14	40.19	13.30	31.71	9.66
2,454	Linseed cake	......	....	......	......	......	....	6.07	31.06	11.74	40.13	11.00
2,042	Cottonseed meal	6.43	7.23	44.61	1.28	28.93	11.52	7.73	47.68	1.36	30.92	12.31
2,172	Gluten feed (wheat)	79.30	.28	6.54	.42	13.38	.08	1.34	31.62	2.01	64.64	0.39

2,203	Wheat bran	14.27	5.71	17.14	8.52	50.33	4.03	6.66	20.00	9.94	58.70	4.70
2,263	Wheat bran	14.33	5.40	15.15	8.51	53.41	3.20	6.31	17.69	9.93	62.33	3.74
2,440	Distillery refuse	......	....	......	......	......	....	3.55	22.25	22.60	43.99	7.61
	MISCELLANEOUS.											
2,099	Refuse hay	22.32	5.14	5.63	30.37	34.26	2.28	6.62	7.25	39.11	44.09	2.93
2,100	Refuse hay	29.01	3.89	5.23	28.03	31.85	1.99	5.48	7.37	39.48	44.86	2.81

ALBUMINOID AND NON-ALBUMINOID NITROGEN.

In nearly all the feeding stuffs albuminoid and non-albuminoid nitrogen has been determined by the modified Stutzer cupric hydrate method.

Laboratory number.	GRASSES.	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.	Per cent of total nitrogen in amide form.
2,357.....	Meadow Foxtail	1.82	1.59	0.23	12.63
2,365.....	Orchard grass	1.52	1.18	0.34	22.36
2,366.....	Tall meadow oat grass	1.21	0.99	0.22	18.18
2,367.....	Kentucky blue grass	1.25	1.02	0.23	18.40
A......	Timothy (average 9)	1.22	1.02	0.20	16.39
B......	Ray grass (average 24)	1.82	1.41	0.41	22.53
2,388.....	Alsike clover	2.44	....	....	....
2,394.....	Alsike clover	2.47	....	....	....
	GREEN FODDERS.				
C......	Prickly comfrey	2.56	2.37	0.19	7.42
2,114.....	Ensilage	1.33	0.78	0.55	41.35
2,455.....	Maize fodder	1.68	1.00	0.68	40.48
	HAYS.				
2,026.....	Timothy A	1.28	.77	0.51	39.83
2,027.....	Timothy B	1.28	.87	0.41	32.03
2,040.....	Hay, mixed	1.43	1.27	0.16	11.18
2,045.....	Orchard grass	1.56	1.29	0.27	17.50
2,088.....	Orchard grass	1.54	1.27	0.27	17.53
2,209.....	Timothy	1.16	1.10	0.06	5.17
2,222.....	Timothy	1.38	1.21	0.17	12.31
2,223.....	Timothy (past bloom)	1.23	1.02	0.21	17.07
2,235.....	Hay, mixed	1.20	1.14	0.06	5.00
	STRAW.				
2,034.....	Oat straw	0.74	0.71	.03	4.05
2,113.....	Maize stover (stalks)	1.34	1.34	0	0
	GRAINS, MEALS, ETC.				
2,112.....	Corn meal	1.88	1.55	0.33	12.23
2,441.....	Oats	2.60	2.47	.13	5.00
2,442.....	Oats	2.44	2.44	0	0
2,443.....	Oats	2.44	2.44	0	0
2,444.....	Oats	2.20	2.10	.10	4.54
	BY PRODUCTS.				
2,042.....	Cottonseed meal	7.63	7.26	0.37	4.86
2,263.....	Wheat bran	2.83	2.46	0.37	13.07

DIGESTIBILITY OF ALBUMINOIDS.

Laboratory number.	FOODS.	Total albuminoids, N x 6.25.	Albuminoids undigested.	Per cent of albuminoids digested.
2,357	Meadow Foxtail	11.37	5.18	54.44
2,365	Orchard grass	9.50	3.44	63.79
2,366	Tall meadow oat	7.56	2.25	70.23
2,367	Kentucky blue grass	7.81	2.75	67.35
A	Timothy (average 9)	7.60	......	59.57
2,114	Ensilage (Maize)	8.31	3.75	54.87
2,455	Maize fodder	10.50	5.50	47.61
2,026	Timothy, A	8.00	3.62	54.75
2,027	Timothy, B	8.00	2.37	64.12
2,088	Orchard grass hay	9.62	3.62	62.37
2,235	Hay, mixed	7.50	3.75	50.00
2,040	Hay, mixed	8.94	4.44	50.33
2,286	Hay (damaged)	7.68	5.13	33.20
2,034	Oat straw	4.63	3.37	27.21
2,113	Corn stover	8.37	4.69	43.96
2,112	Corn meal	11.75	4.25	63.83
2,441	Oats, A	16.25	4.06	75.01
2,442	Oats, B	15.25	6.62	56.59
2,443	Oats, D	15.25	5.37	64.58
2,444	Oats, E	13.75	4.69	65.89
2,032	Linseed meal	40.19	5.69	85.84
2,042	Cottonseed meal	47.68	8.81	83.62
2,203	Bran, wheat	20.00	4.63	76.85
2,263	Bran, wheat	17.69	4.31	75.60

In the following table we give the average composition of foods as compiled from analyses made at this Station during the past seven years:

GRASSES, CLOVER, ETC.—IN BLOOM.	Number analysis.	Water.	Ash.	Albuminoids, N × 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Timothy, 1887	21	57.31	2.08	3.23	13.38	22.64	1.36
Timothy, 1888	9	67.09	1.41	2.50	11.54	16.36	1.10
Timothy seed formed	3	48.14	2.25	3.28	18.16	26.72	1.45
Orchard grass	3	71.48	2.14	2.65	10.23	12.29	1.21
Kentucky Blue or June grass	1	58.76	2.03	3.18	13.29	21.27	1.47
Meadow Fescue	1	68.70	1.97	2.44	10.93	14.82	1.14
Tall Meadow oat	2	69.46	1.73	2.60	10.63	14.38	1.20
Meadow Foxtail	1	72.63	1.71	3.12	8.66	12.72	1.16
Fort Bellingham	2	62.58	2.35	3.33	12.49	17.96	1.29
Wood Meadow grass	1	55.55	2.16	2.86	16.29	21.82	1.32
Bennett's Native Wild	1	57.62	1.88	3.31	16.30	19.44	1.45
Sweet Vernal grass	1	67.41	1.57	2.10	10.74	17.02	1.16
Ox-eye daisies	1	78.46	1.59	1.28	5.62	12,16	.89
Buttercups	1	79.20	1.45	1.56	6.24	10.56	.99
Medium red clover	21	68.34	2.05	4.51	9.77	14.03	1.30
Alsike clover	1	77.29	1.95	3.66	5.32	10.76	1.02
White clover	1	78.23	1.79	4.42	4.70	9.44	1.42
Bokhara clover	1	69.20	1.61	3.52	13.12	11.45	1.10
Lucerne or Alfalfa	4	67.46	2.95	5.91	10.51	12.02	1.15
Yellow trefoil	1	78.52	1.37	3.40	6.21	9.09	1.11
Chess or Cheat	1	60.35	1.85	3.17	13.05	20.46	1.12
FORAGE PLANTS.							
Sorghum	2	84.00	.77	.97	5.23	8.60	.43
Amber canes	3	82.44	.74	1.17	5.94	9.32	.39
Fodder corn	10	80.65	.99	1.54	6.10	10.13	.58
Ensilage, Maize fodder	6	84.14	.96	1.00	5.14	7.92	.84
Ensilage, Maize stover	2	59.29	1.72	3.62	8.11	24.80	2.46
Ensilage, Hungarian	1	60.51	2.75	3.30	13.60	17.51	2.33
Cow pea	2	84.06	1.83	3.12	3.48	6.91	.60
Soja hispida	3	69.87	2.38	3.34	8.36	14.90	1.15
Prickly comfrey	3	84.36	2.45	2.94	2.61	7.13	.51

ROOTS, TUBERS, ETC.	Number analysis.	Water.	Ash.	Albuminoids, N× 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Sweet potatoes	1	74.38	1.34	3.56	2.14	17.98	.60
Potatoes	3	78.49	.84	2.42	.68	17.51	.06
Cabbage, outer leaves	1	89.86	1.35	1.83	2.98	3.51	.47
Turnips	1	92.40	.72	1.25	1.20	4.20	.23
Pumpkins	1	92.27	.63	1.11	1.49	4.34	.16
Mangolds	1	94.41	1.09	1.03	1.00	2.40	.07
Carrots	1	91.13	1.00	1.08	1.41	5.09	.29
Okra	1	87.41	.74	1.99	3.42	6.04	.40
Onion	2	89.26	.45	1.09	.65	8.31	.24
Tomatoes	1	91.26	.73	1.00	.70	5.84	.47
String beans	1	83.46	.83	2.75	2.58	10.04	.34
Apples, sweet	1	77.30	.46	.50	1.37	19.96	.41
Hays.							
Timothy, bloom	21	15.35	4.16	6.59	26.88	44.33	2.69
Timothy, in seed	3	15.35	3.65	5.34	29.65	43.65	2.36
Orchard grass	6	15.35	6.13	8.12	31.14	35.73	3.53
Mixed hays	9	14.80	4.92	6.37	32.30	39.15	2.46
Red clover, in bloom	21	15.35	5.50	12.05	25.99	37.63	3.48
Alsike clover	4	15.35	6.55	11.44	24.95	38.37	3.34
Clover rowen	2	14.33	6.23	11.08	28.80	36.36	3.20
Straw.							
Wheat straw	1	17.86	4.16	2.98	42.74	31.04	1.22
Oat straw	1	16.28	4.83	2.35	36.77	37.97	1.80
Maize stover (field cured)	5	49.01	3.62	3.25	18.78	24.13	1.21
Maize stover (in barn)	1	22.63	5.35	6.47	28.43	35.87	1.25
Soja bean fodder	1	21.23	8.37	8.42	22.34	38.29	1.35
Grain, Meal, Etc.							
Corn	7	10.54	1.57	10.86	2.31	69.21	5.51
Corn meal	20	17.08	1.30	8.80	1.74	67.26	3.82
Wheat, winter	2	13.31	1.57	11.81	3.11	68.57	1.63
Wheat flour	1	13.26	.38	10.50	1.21	73.62	1.03
Oats	6	12.28	2.98	12.19	13.58	54.08	4.79
Pea meal	1	12.08	2.61	21.37	11.06	52.02	.86

GRAIN, MEAL, ETC.—(*Continued*).	Number analysis.	Water.	Ash.	Albuminoids, N x 6.22.	Crude fiber.	Nitrogen-free extract.	Fat.
Beans	1	12.39	3.71	22.17	7.21	53.14	1.38
Sunflower seed	1	12.68	3.00	15.88	29.21	18.71	20.52
BY PRODUCTS.							
Wheat bran	10	13.71	5.53	14.56	10.83	52.26	3.11
Ship stuff	3	14.75	5.27	16.38	6.36	52.66	4.58
Middlings	3	12.41	3.61	15.62	4.22	59.66	4.48
Brewers' grains	6	76.60	.94	4.82	3.82	12.53	1.29
Corn feed (starch feed, etc.)	5	65.40	.21	5.96	3.41	21.51	3.51
Corn feed (dry)	1	6.00	.72	16.04	13.02	58.14	6.08
Gluten meal	6	10.49	.74	21.39	5.62	54.87	6.89
Linseed meal	11	9.83	5.13	31.52	11.54	34.95	7.03
Cottonseed meal	3	11.06	7.39	40.56	3.56	23.86	13.57
Hominy feed	1	12.06	2.61	11.56	5.02	63.31	5.44
MISCELLANEOUS.							
Castor pomace (dry)	1	......	6.36	35.00	31.06	10.76	16.82
Dandelion	2	92.35	1.18	1.83	1.14	3.02	.46
Pie-plant	1	97.06	.48	.62	.65	1.10	.09
Mushrooms	1	89.15	.85	6.08	.76	2.37	.79
Plantains	1	80.84	2.79	2.10	3.09	10.56	.62
Canada Thistle	1	75.39	2.40	2.05	7.28	11.20	1.68

AMOUNT OF FERTILITY REMOVED FROM THE SOIL BY CROPS.

If we burn any of our feeding stuffs there remains a portion unconsumed, which we call the ash, or mineral matter of the plant. This ash is distributed unequally throughout the different parts of the plant, there being less in the seed than in the stem, and less in the stem than in the leaves. There are also great differences in the amount of ash in different classes of plants; that is, plants botanically different, although cultivated plants of the same family usually do not differ greatly in the per cent of ash. Succulent plants, such as the foliage of roots like beets, turnips, etc., sometimes contain as much as 15 to 18 per cent or more ash, while the hays generally contain about 5 to 8 per cent, and the seeds of the cereals—grains—usually not more than 2 to 3 per cent, although a few contain so much as 4 to 6 per cent. This ash is made up of several different elements or constituents, each of which the chemist is able to separate out and weigh by itself, but not in the same form always in which it existed in the plant. There are thirteen of these elements present in the ash of our agricultural plants and the names by which the chemist knows them are as follows: Oxygen, carbon, sulphur, phosphorus, potassium, sodium, calcium, silicon, chlorine, fluorine, iron, magnesium, manganese.

Besides these there are found in a few plants other elements, such as aluminum in wheat and iodine in some of our sea plants. The amount of fluorine in plants is very small, seldom more than a trace, and of iron there is rarely found more than one per cent. Yet this small amount of iron is an absolute essential for the development of the normal plants. If there is a lack of iron the plant becomes pale, and the leaves are white and growth stops; but let iron be supplied to such a plant and the leaves again become of a deep green, healthy color. The plant secures its oxygen and carbon from the air, but the other elements all come from the soil, which is the only source of supply. The chemist in separating these elements of the ash, determines them in some form of their compounds and in the analysis he gives names more familiar to the farmer, as follows, using also certain letters and figures as abbreviations or symbols for the real form:

Phosphoric acid (anhydride P_2O_5).
Sulphuric acid (or anhydride SO_3).
Carbonic acid (or anhydride CO_2).
Potash, K_2O.
Soda, Na_2O).
Lime, CaO (calcium).
Silica, SiO_2.
Ferric oxide, Fe_2O_3 (iron).
Magnesia, MgO.

By stating the elemental compounds in the above form the chemist does not mean to say that they always are found in the plants in just this form, for in the plant the elements are combined in several forms, and these combinations sometimes change as the plants approach maturity. Thus phosphorus, nor phosphoric anhydride, does not exist free as such in the plant, but in some combination, such, for instance, as phosphate of lime. The amount of potassium, calcium, phosphorus, etc., in different plants is not the same, and the farmer needs to become familiar with the wants of his different plants, just as he is with the wants of his different animals.

The farmer knows that the cow and hog will not always do equally well upon the same kind of food, for they belong to different classes, and their habits are quite different. This is just as true of different classes of plants, that is, plants botanically different, such as beets and the grains, or clover and timothy; clover being a leguminous plant of the same family as peas, beans, etc., and timothy one of the grass family. Some plants like large quantities of potassium and require less of phosphorus to do well; others need an abundance of phosphorus and less potassium, while there are others that take up a great deal of calcium. The clovers all require large amounts of potash and lime. The grains need phosphoric acid and potash, and roots require that there be present in the soil an abundance of available potash.

The farmer, in order to succeed as well in growing field crops as with his animals, should become familiar with the needs of the plants themselves as he is with the proper kinds of foods for his domestic animals. He should find out in what his soil stands in the greatest need, and then in growing crops, knowing their need, he will be able to purchase just that class of fertilizers which furnish the required food for his crops. Of these mineral elements there are but two to which special prominence is given in commercial fertilizers, for in most soils the others are present in sufficient quantity, although the application to the soil of many of the other ash ingredients may be followed by most beneficial results, either from their chemical or physical action in the soil. Phosphoric acid and potash are the two ash ingredients which enter into our commercial fertilizers, but both lime and sulphuric acid are essential ingredients of all super-phosphates. Potash is supplied either in the form of wood ashes or as potash salts, like the sulphate and muriate of potash, which come largely from the German mines.

Besides these ash elements there is also required nitrogen for plant growth, and this is by far the most costly part of plant food.

In their power to gather nitrogen plants differ greatly, the clovers and other leguminous plants being able to produce a good crop where the grasses or cereals would entirely fail. In fertilizers there are several sources of the supply of nitrogen, such as ammonia salts, nitrate of soda (Chili saltpetre), blood, meat and fish scraps, leather, hair, cottonseed, castor pomace, etc. Of these leather and hair are worthless for immediate supply of nitrogen, for they are decomposed in the soil only after a long time. Ammonia salts and nitrate of soda are the most valuable, as the nitrogen of these salts are in a form to be used by the plant, and in these forms nitrogen costs most. Organic nitrogen, such as exists in cottonseed meal, linseed meal or castor pomace, soon becomes in the soil available for the use of the plant, and whatever of fertilizing matter the farmer purchases in the way of feeding-stuffs is secured with the least cost when it has been converted into manure.

In our feeding stuffs by dividing the per cent of albuminoids (or protein of some chemists) by 6¼ we have the per cent of nitrogen or pounds in one hundred of the substance.

During the past two years we have made analyses of many of our most common foods, and in the first table we give the composition of the ash of quite a number of these products; also the per cent of nitrogen. In the second table are given the number of pounds of phosphoric anhydride, potassium oxide, calcium and nitrogen. This will enable the farmer to get a pretty good idea of the amount of fertilizing matter in the most common foods. In the last column of table II we give the valuation of the fertilizing matters, considering nitrogen worth 17 cents per pound, phosphoric acid 8 cents and potash 5½ cents, while to the lime no value is assigned. The above is about what nitrogen, phosphoric acid and potash cost in the markets when purchased as ammonia salts, soluble phosphates and potash salts.

In a few instances determinations were made only for the principal fertilizing constituents.

TABLE No. I.

COMPOSITION OF THE ASH OF SOME FEEDING STUFFS, ALSO PER CENT NITROGEN.

	Ash.	Phosphoric acid, P_2O_5.	Potash, K_2O.	Soda, Na_2O.	Lime, CaO.	Magnesia, MgO.	Nitrogen, N.
Timothy	4.99	5·93	34.19	5.45	8.69	1.93	1.24
Orchard grass	6.95	7.40	42.72	0.47	7.20	2.11	1.30
June grass	4.72	9.16	34.97	......	7.12	1.65	1.25
Meadow fescue	6.05	7.03	31.56	5.28	11.84	3.35	1.25
Tall meadow oat	5.94	7.16	34.60	7.04	7.76	3.07	1.37
Meadow foxtail	6.53	7.93	39.61	8.66	7.80	2.20	1.82
Ox-eye daisies	7.38	4.32	35.70	1.00	......	....	0.95
Buttercup	7.02	6.86	13.66	18.32	......	....	1.20
Yellow trefoil	6.40	7.88	18.00	2.78	33.36	3·56	2.53
Medium red clover	6.49	4.51	20.38	8.51	29.98	4.23	2.28
Aliske clover	8.57	5.20	33.42	......	25.93	4.62	2.16
White clover	8.24	7.49	26.04	0.92	......	....	3.25
Lucerne, alfalfa	8.71	6.29	18.84	1.55	37.07	2.16	2.37
Prickly comfrey	14.83	3.73	25.93	7.35	18.72	2.05	2.77
Maize fodders	6.12	5.17	23.94	19.84	25.36	4.84	1.27
Oat straw	5.80	1.17	27.76	4.82	9.28	.95	0.45
Wheat straw	5.07	2.45	12.60	5.47	5.68	1.52	0.58
Maize stover	7.19	1.79	12.05	15.60	12.33	4.63	1.11
Corn	1.67	54.48	28.53	6.79	2.64	6.83	1.66
Wheat	1.81	46.00	23.35	3.64	4.19	6.76	2.18
Flour	0.43	52.32	30.94	2.60	7.40	4.45	1.68
Wheat bran	5.93	50.50	16.63	1.58	2.50	7.00	2.74
Ship stuff	5.76	40.68	19.52	1.96	2.50	5.94	3.04
Middlings (wheat)	3.93	50.08	18.22	0.15	1.83	2.24	2.82
Oats	3.42	25.52	15.61	5.39	3.29	3.16	2.24
Linseed meal	5.75	30.08	22.00	9.96	11.36	7.85	5.59
Cottonseed meal	7.34	43.56	29.04	10.00	4.08	6.52	7.53
Corn cobs	1.98	0.36	51.48	2.08	1.76	0.96	0.25
Beets	19.55	4.78	41.25	3.80	1.68	1.47	......

TABLE No. II.

AMOUNT OF FERTILIZING MATTER IN ONE TON (2,000 LBS.) OF VARIOUS FEEDING STUFFS.

	Phosporic acid, P_2O_5, lbs.	Potash, K_2O, lbs.	Lime, CaO, lbs.	Nitrogen, lbs.	Valuation.
Timothy	5.0	27.5	7.2	21.0	$5 48
Orchard grass	8.2	38.5	8.3	22.0	6 51
June grass	7.3	29.2	4.0	21.1	5 77
Meadow fescue	7.2	32.3	12.1	21.1	6 03
Tall meadow oat	6.4	34.4	7.0	23.2	6 34
Meadow foxtail	8.8	43.8	8.4	30.8	8 24
Ox-eye daisies	5.4	44.6	....	16.1	5 62
Buttercups	8.1	16.2	....	20.3	4 79
Yellow trefoil	8.5	19.5	36.1	42.8	9 02
Medium red clover	5.2	22.4	33.0	38.6	8 20
Alsike clover	7.5	48.5	37.6	36.5	9 47
White clover	10.4	36.3	51.7	55.0	12 17
Lucerne, alfalfa	9.3	27.8	54.6	40.2	9 10
Prickly comfrey (fresh)	2.1	14.9	10.7	8.4	2 42
Maize fodder (fresh)	1.2	5.7	5.9	4.9	1 28
Oat straw	1.2	27.0	9.0	7.6	2 86
Wheat straw	2.0	10.5	4.7	9.5	2 35
Maize stover	2.0	13.2	13.7	17.2	3 80
Corn	15.1	7.9	1.9	27.5	6 31
Wheat	14.4	5.5	1.3	37.8	7 77
Flour	3.8	2.4	....	29.2	5 49
Wheat bran	51.7	17.0	2.5	47.3	13 10
Shipstuff	39.9	19.1	2.4	51.8	13 04
Middlings (wheat)	34.5	12.5	1.3	49.4	11 85
Oats	11.9	9.8	2.1	39.3	8 17
Linseed meal	38.0	22.8	11.8	100.8	21 42
Cottonseed meal	55.6	37.8	5.3	130.4	28 68
Corn cobs	0.2	16.2	....	4.6	1 68
Butter	....	....	....	....	26
Milk	4.0	3.4	....	14.0	2.80

In order to show more plainly to the eye the variation in the composition of the ash of several of our more common feeding stuffs, I have prepared two plates to accompany this article. Plate I shows the per cent or pounds in one hundred of the ash of phosphoric acid potash and lime, while the blank space shows the total per cent of other constituents, as soda, magnesia, iron, silicon, etc.

Plate II shows the relative amount of phosphoric acid, potash, and nitrogen in one ton (2,000 lbs.), taking cottonseed meal as our standard; that is, one ton of cottonseed meal was found to contain the most pounds (223.8 lbs.), of fertilizing matter of any feed examined, and in comparison with this the others stand as shown by the plate.

INFLUENCE OF FERTILIZERS UPON THE CHEMICAL COMPOSITION OF GRASS. 1887.

In my report for 1887 I gave the result of an investigation upon the influence of several fertilizing ingredients on the chemical composition of timothy and clover. In the experiment there reported the fertilizers were spread upon the surface of a field which had already been in grass for five years. In the experiment now under consideration, carried out in the same year as above, the fertilizers were applied to a plat well cultivated and then put down to grass. The grass selected for the purpose of this experiment was an annual *Lolium Italicum.* A one-tenth acre plat was divided into 24 small plots and the fertilizers applied and the whole laid down to grass April 26. I may add that this plat had not been previously fertilized since the establishment of the Station.

The following table gives the rate at which the different fertilizing ingredients were applied:

Plate, I.

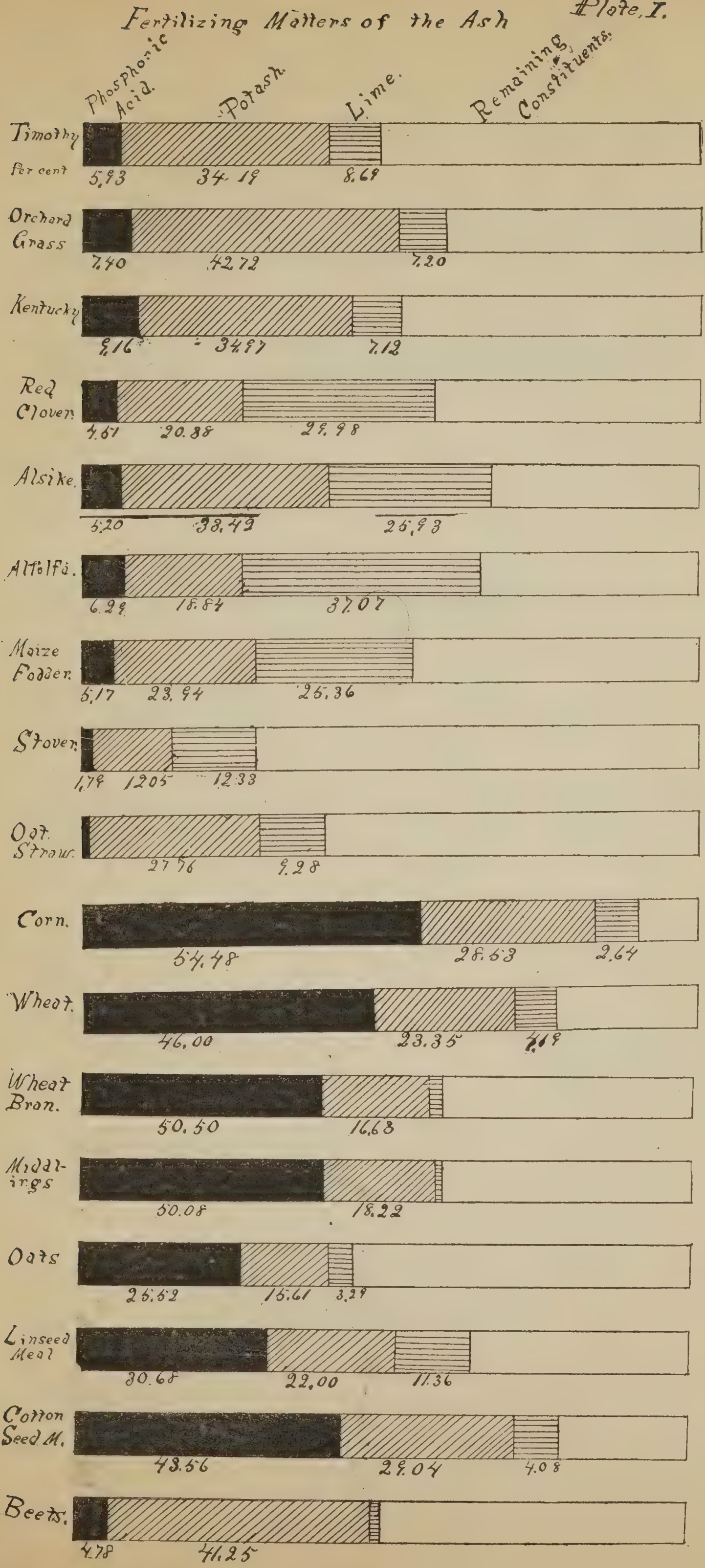
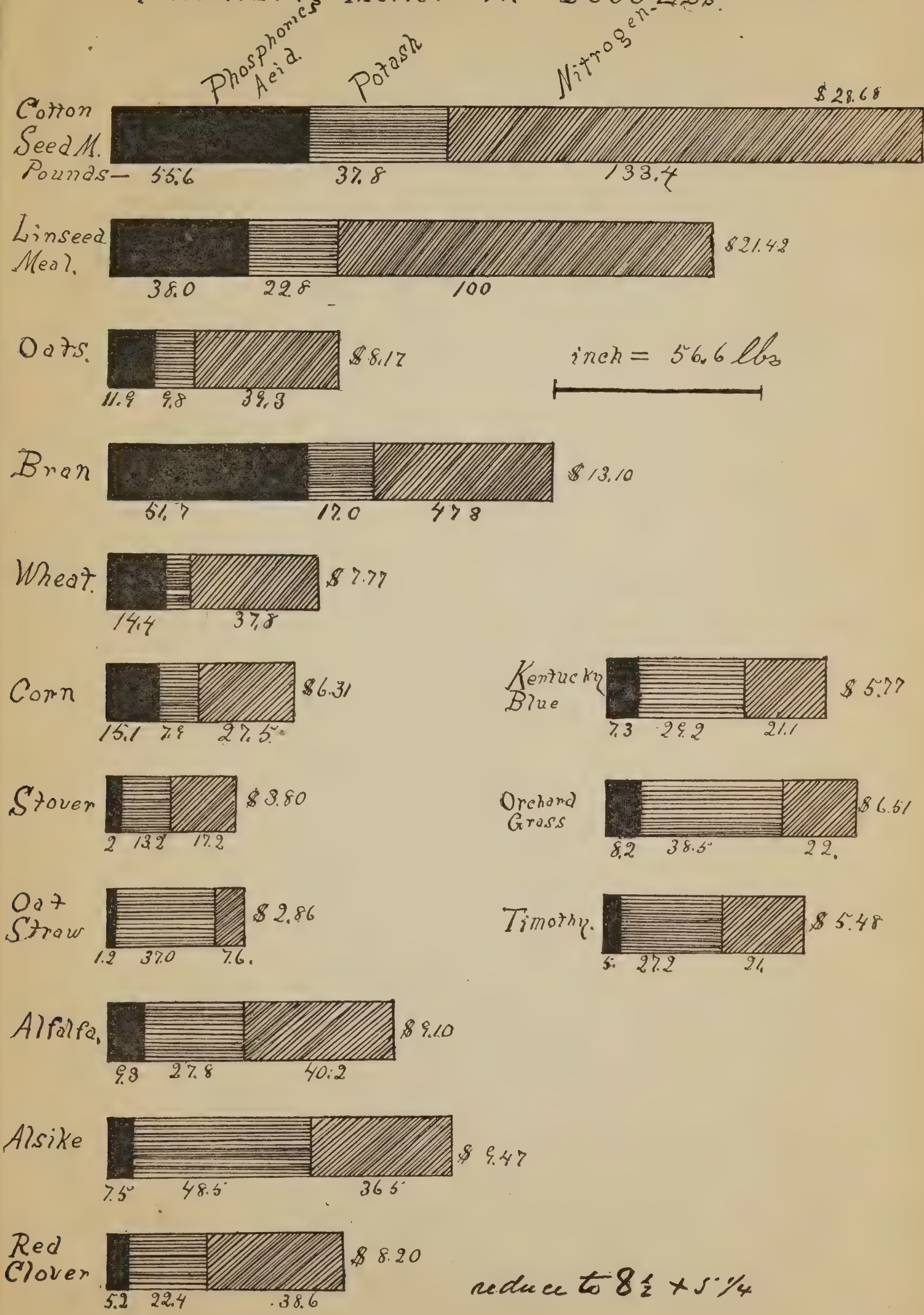

Fertilizing Matters of the Ash
Phosphoric Acid.
Potash
Lime.
Remaining Constituents.
Timothy
Per cent
5.93
34.19
8.69
Orchard Grass
7.40
42.72
7.20
Kentucky
8.16
34.97
7.12
Red Clover
4.61
20.88
29.98
Alsike.
5.20
33.49
25.93
Alfolfa.
6.29
18.84
37.07
Maize Fodder.
5.17
23.94
25.36
Stover.
1.79
12.05
12.33
Oat. Straw.
27.76
9.28
Corn.
54.48
28.53
2.64
Wheat.
46.00
23.35
4.19
Wheat Bran.
50.50
16.63
Middlings
50.08
18.22
Oats
26.52
15.61
3.29
Linseed Meal
30.68
22.00
11.36
Cotton Seed M.
43.56
29.04
4.08
Beets.
4.78
41.25

Plate II.

Fertilizing Matter in 2000 Lbs.



reduce to 8½ × 5¼

Fertilizers.— Pounds per Acre.

PLAT.	Sulphate of potash.	Muriate of potash.	Sulphate of ammonia.	Nitrate of soda.	Acid phosphate.	Ferrous sulphate.	Lime.	Gypsum.	Sodium chloride.	Barn manure.
I......	300	....	....	....	....	..	....	....	....	....
II......	....	....	150	....	....	..	....	....	....	....
III......	....	....	....	....	350	..	....	....	....	....
IV......	300	....	150	....	350	..	....	....	....	....
V.....	300	....	....	....	350	..	....	....	....	....
VI......	300	....	150	....	....	..	....	...	....	....
VII......	....	....	150	....	350	..	....	....	....	....
VIII......	....	....	150	....	350	..	350	....	....	....
IX......	300	....	150	...	....	..	350	....	....	....
X......	300	....	150	....	350	..	350	....	....	....
XI......	....	....	150	....	....	..	350	550	....	....
XII......	300	....	150	....	350	..	....	550	....	....
XIII......	....	....	....	....	....	..	350	....	....	....
XIV......	....	....	....	....	....	..	....	550	....	....
XV......	....	....	....	....	....	..	....	....	....	....
XVI......	....	....	....	....	....	..	....	....	100	....
XVII......	....	....	....	180	....	..	....	....	....	....
XVIII......	....	....	150	....	....	..	....	....	....	....
XIX......	...	150	....	....	....	..	....	....	....	....
XX......	300	....	....	....	....	..	....	....	....	....
XXI......	....	....	....	....	....	50	....	....	....	....
XXII......	....	....	....	....	....	..	....	....	....	manure.
XXIII	....	....	....	....	....	..	....	....	....	....
XXIV......	....	....	....	....	....	..	....	....	....	....

From the backwardness of the spring the grass was slow to start and had not come into blossom as was intended at the date of sampling. When cut only a few of the plants had reached the period of bloom. The following table shows the composition of the grass from the several plats :

LOLIUM ITALICUM.

PLAT.	Fresh Substance.						Dry Substance.				
	Water.	Ash.	Albuminoids, N× 6.25.	Crude fiber.	Nitrogen-free extract.	Fat (ether extract).	Ash.	Albuminoids, N× 6.25.	Crude fiber.	Nitrogen-free extract.	Fat (ether extract).
I	74.00	2.69	3.36	6.57	11.88	1.55	10.36	12.93	25.28	45.46	5.97
II	74.03	2.65	3.36	6.16	12.53	1.27	10.19	13.25	23.74	47.92	4.90
III	73.14	2.50	3.00	6.78	13.24	1.34	9.33	11.19	25.22	49.22	5.01
IV	73.83	2.51	3.16	6.60	12.39	1.51	9.61	12.06	25.26	47.33	5.78
V	72.51	2.53	2.94	6.94	13.73	1.35	9.20	10.69	26.50	49.95	4.90
VI	74.53	2.49	3.12	6.75	11.95	1.16	9.78	12.25	24.66	46.89	4.58
VII	73.15	2.48	3.00	6.62	13.37	1.38	9.25	11.19	26.11	49.77	5.13
VIII	74.26	2.44	3.14	6.72	12.00	1.44	9.48	12.19	24.03	46.61	5.61
IX	76.10	2.14	3.25	5.74	11.53	1.24	8.97	13.62	22.97	48.20	5.18
X	75.92	2.22	3.14	5.53	11.93	1.26	9.24	13.06	26.59	49.49	5.24
XI	74.13	2.33	3.30	6.88	11.94	1.42	9.00	12.75	25.76	46.16	5.50
XII	75.03	2.40	2.84	6.43	12.18	1.12	9.62	11.37	24.01	48.75	4.50
XIII	74.39	2.13	3.22	6.15	12.84	1.27	8.34	12.56	23.91	50.11	4.98
XIV	69.55	2.48	3.77	7.28	15.42	1.50	8.16	12.37	24.60	50.63	4.93
XV	71.53	2.44	2.90	7.00	14.82	1.31	8.56	10.19	25.54	52.03	4.62
XVI	73.41	2.58	2.84	6.79	13.24	1.14	9.72	10.70	26.09	49.76	4.28

XVII	74.84	2.32	2.66	6.56	12.54	1.08	9.22	10.56	25.12	49.85	4.28
XVIII	76.61	2.11	2.57	5.87	11.72	1.12	9.04	11.00	25.12	50.04	4.80
XIX	71.51	2.35	3.05	7.02	14.61	1.46	8.27	10.70	24.63	51.27	5.13
XX	71.42	2.46	3.29	6.75	13.63	1.45	8.94	11.94	24.48	49.38	5.26
XXI	72.33	2.54	2.59	6.94	14.33	1.27	9.18	9.37	25.09	51.76	4.60
XXII	70.65	2.75	2.66	7.53	15.10	1.38	9.39	9.06	25.65	51.19	4.71
XXIII	70.02	2.70	2.62	8.34	14.82	1.50	8.70	8.75	25.15	52.38	5.02
XXIV	71.96	2.53	2.70	7.30	14.26	1.25	9.03	9.62	26.04	50.84	4.47
Average	73.16	2.46	3.06	6.72	13.27	1.33	9.19	11.39	25.09	49.38	4.95

ALBUMINOID AND NON-ALBUMINOID NITROGEN.

The proportion of albuminoid and non-albuminoid nitrogen was determined, with results as shown in the following table:

PLAT.	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.	Per cent total nitrogen in amide form.
I	2.07	1.63	.44	21.25
II	2.12	1.53	.59	27.83
III	1.79	1.47	.32	17.31
IV	1.93	1.54	.39	20.20
V	1.71	1.49	.22	12.86
VI	1.96	1.40	.56	28.57
VII	1.79	1.47	.32	17.86
VIII	1.95	1.51	.44	22.56
IX	2.18	1.88	.30	13.76
X	2.09	.79	1.30	62.20
XI	2.04	.86	1.18	57.84
XII	1.82	1.48	.34	18.67
XIII	2.01	1.73	.28	13.93
XIV	1.98	1.62	.36	18.18
XV	1.63	1.27	.36	22.08
XVI	1.68	1.40	.28	16.66
XVII	1.69	1.38	.31	18.34
XVIII	1.76	1.46	.30	17.04
XIX	1.68	1.40	.28	16.16
XX	1.91	1.66	.25	13.09
XXI	1.50	1.32	.18	12.00
XXII	1.45	1.27	.18	12.41
XXIII	1.40	1.38	.02	1.43
XXIV	1.54	....	....	....

SUGARS AND STARCH.

In the following table are presented the per cent of sugars and starch for a few samples:

PLAT.	Invert sugar.	Sucrose	Starch	Per cent of nitrogen-free extract as sugars and starch.
I	4.16	4.12	....	....
II	5.12	5.00	....	....
III	3.40	4.60	....	....
IV	2.36	5.24	....	....

DIGESTIBILITY.

The digestibility of the albuminoids of the grasses from the several plats was also determined by the pepsin method, and the results are given in the following table :

PLAT.	Total albuminoids N x 6.25.	True albuminoids.	Per cent albuminoids undigested.	Per cent total albuminoids digested.	Per cent true albuminoids digested.
I	12.93	10.19	5.75	55.53	43.57
II	13.25	9.56	5.50	57.46	42.47
III	11.19	9.19	5.19	53.61	43.52
IV	12.06	9.62	5.94	50.74	48.64
V	10.69	9.31	5.06	52.66	45.65
VI	12.25	8.75	4.62	62.28	47.20
VII	11.19	9.19	5.44	51.38	40.80
VIII	12.19	9.44	6.25	44.62	33.79
IX	13.62	11.75	5.62	58.73	52.17
X	13.06	4.94	4.87	62.71	1.41
XI	12.75	5.44	5.69	55.37	.....
XII	11.37	9.25	4.44	60.94	52.00
XIII	12.56	10.81	5.62	55.25	48.01
XIV	12.37	10.12	4.87	60.63	51.77
XV	10.19	7.94	4.75	53.38	40.17
XVI	10.70	8.75	4.62	56.82	48.34
XVII	10.56	8.62	4.19	60.32	51.39
XVIII	11.00	9.12	4.81	61.72	47.25
XIX	10.70	8.75	3.87	63.83	55.77
XX	11.94	10.37	6.00	49.75	42.14
XXI	9.37	8.25	4.56	51.33	44.72
XXII	9.06	7.94	.....	.....	.....
XXIII	8.75	8.62	4.56	47.86	47.10
XXIV	9.62	.....	3.75	61.01	.....

As in the case with the experiment previously reported, no influence of the fertilizers upon the chemical composition of the grasses could be traced for the series of experiments. Had we stopped here we might fairly have concluded that the influence of the fertilizers was manifest, not upon the chemical composition of grasses, but almost entirely in an increase of the crop, as has been noted.* This increase was very marked for the nitrogenous fertilizers, particularly sodium nitrate; but the results for the season of 1888 give marked difference in the chemical composition of the grass, as shown by the next topic.

INFLUENCE OF FERTILIZERS ON THE CHEMICAL COMPOSITION OF GRASSES. 1888.

In my report† for 1887 I gave the results for a large number of trials with the application of different fertilizing ingredients, both singly and combined, upon grass land, in order to determine what influences they exerted upon the chemical composition of the grass. In this experiment there were twenty-one plats growing both timothy and red clover, and we could find no difference in composition which could be attributed to the influence of the fertilizer, or, to quote from that report, the conclusions arrived at were as follows:

"The results obtained from the experiments of this year, to determine the influence of fertilizers upon the composition of timothy and clover, show us nothing as to the possible influence of fertilizers. The soil upon which we are experimenting, it seems, is sufficiently rich to produce good crops, under favorable conditions, without the use of fertilizers for immediate effect. The timothy hay grown upon the unfertilized plat XV was richer in albuminoids and nitrogen-free extract than was the average for the entire plats, although many of them were heavily fertilized. The greatest variation in the composition of the timothies, differently fertilized, is far less than the variation in the chemical composition of timothy for two successive years of growth upon the same plats, under like conditions and without fertilizers, so far as field culture furnishes this."

The following brief summary will show the results secured in that trial from a few of the plats for the timothy:

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* Sixth Annual Report of New York Agricultural Experiment Station, p. 441.

† Sixth Annual Report of the New York Agricultural Experiment Station, 1887, p. 441.

PLAT.	Ash.	Albuminoids N x 6.25.	Crude fiber.	Nitrogen-free extract.	Fat (ether extract).
I	4.33	6.94	31.13	54.57	3.03
III	5.11	7.50	32.70	51.04	3.65
XII	5.15	8.44	31.91	51.16	3.34
XV	5.54	8.12	30.65	52.62	4.07
XVIII	5.06	6.94	31.18	53.29	3.53
Average	4.92	7.79	31.75	52.36	3.18

The plats given above as an illustration were fertilized as follows:

Plat I. Sulphate of potash.
Plat III. Acid phosphate.
Plat XII. Sulphate of potash, sulphate of ammonia and acid phosphate.
Plat XV. Nothing.
Plat XVIII. Sulphate of ammonia.

Besides the above reported plats there were also 24 other plats newly laid down to ray grass (Lolium italicum), the fertilization being the same as in the preceding case. No difference in composition could be found in this experiment which could be attributed to the effect of the fertilizers used.

The present season the experiment has been again repeated. The farm superintendent, Mr. Emery, made the application of similar fertilizing materials to a number of trial plats, and while in bloom samples of these grasses were taken by him for analysis. The grasses* from a portion of these plats have been analyzed and those examined were fertilized, on the sod, as below:

Plat A. Sodium nitrate.
Plat B. Ammonium sulphate.
Plat C. Barn manure.
Plat D. Potassium nitrate.
Plats E, J. and O. Nothing.
Plat F. Potassium sulphate.
Plat G. Muck.
Plat H. Bone black.

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* Reference to the report of the farm superintendent will show more fully the real nature and purpose of this experiment.

Plat K. Bone black, sodium nitrate and ammonium sulphate.

The analyses of the grasses from these several plats gave results as shown by the next table :

PLAT.	FRESH SUBSTANCE.						DRY SUBSTANCE.				
	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat (ether extract).	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat (ether extract).
A	66.66	1.44	3.12	12.00	15.69	1.09	4.34	9.37	36.01	47.01	3.27
B	65.74	1.39	3.06	11.86	16.59	1.36	4.08	8.94	34.62	48.40	3.96
C	68.22	1.42	2.32	10.83	16.17	1.04	4.46	7.31	34.08	50.86	3.29
D	67.26	1.39	2.93	11.89	15.36	1.17	4.24	8.94	36.33	46.91	3.58
E, J and O	67.17	1.53	2.15	11.80	16.35	1.00	4.66	6.56	35.94	49.79	3.05
F	67.08	1.47	3.08	11.70	16.63	1.04	4.48	6.31	35.54	52.50	3.17
G	66.66	1.34	1.90	10.88	18.14	1.08	4.03	5.71	32.64	54.38	3.24
H	68.00	1.37	2.06	10.82	16.75	1.00	4.27	6.44	33.78	52.48	3.13
K	67.01	1.32	2.92	12.07	15.43	1.25	4.00	8.87	36.59	47.05	3.49
Average	67.09	1.41	2.50	11.54	16.36	1.10	4.28	7.60	35.06	49.71	3.35

ALBUMINOID AND NON-ALBUMINOID NITROGEN.

The following tables gives the per cent of albuminoid and non-albuminoid nitrogen as determined by Stutzer's methods :

PLAT.	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.	Per cent of total nitrogen in amide form.
A	1.50	1.17	.33	22.00
B	1.43	1.27	.16	11.19
C	1.17	.97	.20	17.09
D	1.43	1.17	.26	18.18
E, J and O	1.06	.83	.23	21.69
F	1.01	.80	.21	20.79
G	.93	.91	.02	2.15
H	1.03	.94	.09	8.73
K	1.42	1.12	.30	21.12
Average	1.22	1.02	.20	16.39

SUGARS AND STARCH.

The per cent. of sugars and starch for the dry substance of the the hay is shown by the following table:

PLAT.	Invert sugar.	Sucrose.	Starch.	Per cent of nitrogen-free extract as sugars and starch.
A	4.75	4.90	27.50	79.02
B	6.20	5.25	26.75	78.92
C	4.80	5.00	25.00	68.42
D	3.95	3.00	29.90	78.55
E, J and O	4.85	3.40	28.45	73.71
F	6.75	6.00	19.48	61.39
G	9.40	5.00	21.40	65.83
H	7.40	5.25	17.20	56.88
K	3.25	3.10	22.12	60.51
Average	5.72	4.54	24.20	69.24

The results obtained the present season are the exact opposite of those for 1887. The plats of grass in an adjoining field of similar soil were treated in the same manner as those of the previous season, and we find differences in the chemical composition of the grasses no less marked than was the influence of the fertilizers on the yield. Whenever a nitrogenous fertilizer was used there was a considerable increase in the albuminoids of the hay. To show plainly the difference let us bring together here the per cent of albuminoids in the dry substance of the hay and the kind of fertilizer used upon the several plats:

Plat.	Per cent of albuminoids.	Fertilizer.
A	8.94	Sodium nitrate.
B	9.37	Ammonium sulphate.
C	7.31	Barn manure.
D	8.94	Potassium nitrate.
E, J and O	6.56	Nothing.
F	6.31	Potassium sulphate.
G	5.71	Muck.
H	6.44	Bone black.
K	8.87	Complete manure.

Observe that the lowest per cent of albuminoids was with muck, and that neither potassium, phosphoric acid (bone black) nor a combination of these gave any increased per cent of albuminoids. The highest results was with sodium nitrate, and it is further noticeable that the per cent of crude fiber is greatest with the highest per cent of albuminoids. Before going further let us present such meteorological* data as we have and see if any additional light can be gained to aid in explaining the difference in the results for two years. In periods of ten days each we tabulate the data from April 1 to the close of June:

	April 1-10.	April 10-20.	April 20-30.	May 1-10.	May 10-20.	May 20-31.	June 1-10.	June 10-20.	June 20-30.	Average or total.
Noon temperature, 1886	39.6	60.1	61.2	60.7	62.5	67.1	71.5	72.6	71.3	63.1
Noon temperature, 1887	48.0	41.6	52.5	70.4	70.4	71.6	68.1	77.9	75.1	63.9
Noon temperature, 1888	37.9	42.8	62.7	65.9	52.7	67.1	69.2	76.7	76.3	61.2
Noon soil temperature, 3 inch., 1886	42.1	57.0	61.0	61.8	61.3	65.8	71.6	74.8	71,1	62.3
Noon soil temperature, 3 inch., 1887	.....	45.6	50.9	65.5	69.1	71.5	69.8	76.9	76.6	65.7
Noon soil temperature, 3 inch., 1888	39.0	42.5	49.4	54.2	54.0	63.9	66.6	74.7	75.2	57.7
Noon soil temperature, 9 inch., 1886	38.2	49.2	54.4	56.4	55.6	56.9	62.9	68.7	65.2	56.3
Noon soil temperature, 9 inch., 1887	.....	42.1	44.6	55.8	59.7	62.6	63.4	66.7	65.6	57.5
Noon soil temperature, 9 inch., 1888	35.8	39.2	43.5	50.1	51.5	57.5	60.9	66.7	69.7	52.7
Rainfall, 1886	30.5	.27	.81	.66	.91	.35	.44	.39	2.09	8.97
Rainfall, 1887	0	.34	1.03	.04	0	.42	.76	.64	.61	3.84
Rainfall, 1888	2.27	0.79	0.03	0.52	1.09	1.18	.08	.41	3.39	9.76

The fertilizers were applied to the several plats both years as a surface dressing about the first of May. An inspection of the table just presented shows the month of May to have been much colder for the present season than for 1887, which undoubtedly exerted an influence, but how or to what extent can not at present be fully determined. If we observe the amount of rainfall for the two seasons we find marked differences. In 1887 the first twenty days of May had only four one-hundredths of an inch rainfall and less than one-half inch for the month. On the other hand, May, 1888, has a record of more than a half inch for the first ten days, and 1.61 inches by the twentieth of the month, with a total of 2.79 inches for the month, well distributed over the thirty-one days.

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* Unfortunately, the record for sunshine for the early part of 1888 was not recorded, so that this valuable adjunct to our study must be passed over for the present season.

Our experiments and observations for the past two years leads us to the following conclusion :

That the application to the soil in the spring of a nitrogenous fertilizer as a top-dressing, will be followed by an increase in the per cent of albuminoids of the hay, providing the temperature is favorable, if there is present sufficient soil moisture. But if the soil is not kept moist by rains after the application of the fertilizer, then there will be little or no effect on the chemical composition of the grass.

Digestibility.

The digestion coefficients for each sample of hay are shown by the following :

PLAT.	Crude albuminoids, N x 6.25.	True albuminoids.	Albuminoids, undigested.	Per cent of crude albuminoids digested.	Per cent of true albuminoids, digested.
A	9.37	7.31	3.56	62.00	51.16
B	8.94	7.94	3.75	58.05	52.64
C	7.31	6.06	3.06	58.14	49.50
E, J and O	6.56	5.19	2.44	62.80	52.99
F	6.31	5.00	2.12	66.40	57.60
G	5.71	5.69	2.25	60.59	60.47
H	6.44	5.87	2.44	62.11	58.43
K	8.87	7.00	3.37	62.00	51 85
Average	7.60	6.37	2.87	61.51	54.33

Ash Analyses.

Partial analyses of the ash from some of the plats were made with results as follows:

PLAT.	Ash.	Phosphoric acid, P_2O_5.	Potash, K_2O.	Soda, Na_2O.	Lime, CaO.	Magnesia, MgO.
A	4.51	3.12	20.06	2.12	4.40	1.14
E, J & O	4.55	4.86	20.31	11.18	4.04	1.23
F	4.44	4.57	20.15	2.40	3.60	.91
K	4.13	4.76	19.68	6.88	3.28	.99

To recalculate our figures for the ash, on the dry substance of the hay, we have:

PLAT.	Phosphoric acid, P_2O_5.	Potash, K_2O.	Soda, Na_2O.	Lime, Ca O.	Magnesia, MgO.
A	.141	.904	.095	.187	.051
E., J. & O	.221	.924	.508	.184	.056
F	.203	.894	.110	.159	.040
K	.196	.813	.284	.135	.041

OATS — SPECIALLY FERTILIZED.

The oats grown upon four separate plats, specially fertilized, were subjected to chemical analysis, and the results are shown by the accompanying table:

PLAT.	FRESH SUBSTANCE.						DRY SUBSTANCE.				
	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.
A	11.11	2.81	14.44	12.40	54.28	4.96	3.16	16.25	13.95	61.06	5.58
B	11.86	2.81	13.44	11.50	55.03	5.36	3.19	15.25	13.05	62.43	6.08
D	12.07	2.89	13.41	12.76	53.53	5.34	3.29	15.25	14.51	60.87	6.08
E	11.36	3.22	11.19	12.76	55.88	5.59	3.63	13.75	14.40	61.91	6.31
Average	11.60	2.93	13.12	12.35	54.69	5.31	3.31	15.12	13.97	61.59	6.01

The plats were fertilized as shown by the following:

	Pounds per acre.	Fertilizers.
Plat A	300	Sodium nitrate.
Plat B	250	Ammonium sulphate.
Plat D	350	Potassium nitrate.
Plat E		Nothing.

From an inspection of the table of analyses it is shown that sodium nitrate exerted a marked influence on the chemical composition of the oats, increasing the per cent of albuminoids 2.50 over plat E, where no fertilizer was used. Potassium nitrate and ammonium sulphate affected similarly the oats, but to a less degree than did sodium nitrate.

Analysis of the crude ash from the oats gave the following results:

PLAT.	Ash.	Phosphoric acid, P_2O_5.	Potash, K_2O.	Soda, Na_2O.	Lime, CaO.	Magnesia, MgO.
A	3.19	21.64	17.82	3.29	1.68	3.36
B	3.32	20.36	16.06	5.04	4.32	3.33
E	3.63	18.42	16.06	11.12	3.84	3.35

The ash constituents, calculated in the dry substance of the oats, gave as follows:

PLAT.	Phosphoric acid, P_2O_5.	Potash, K_2O.	Lime, CaO.	Magnesia, MgO.	Nitrogen.
A	0.690	0.568	0.053	0.107	2.60
B	0.676	0.533	0.143	0.110	2.44
F	0.668	0.583	0.139	0.121	2.20
Average	0.678	0.561	0.112	0.112	2.41

The analysis of the oats from the several plats differently fertilized shows that there was little influence of the fertilizer upon the composition of the ash, for when calculated in the dry substance the differences in composition are very small.

The amount of chemical work on hand at the time prevented our making analyses of the straw, but if we assume that the composition of the straw was the same as that for other samples analyzed from the same field in previous years, then we can calculate the amounts of the several fertilizing ingredients removed per acre by such a crop of oats. As the variation from former analyses for straw can not be great, we use these figures for estimating the average amount removed.

The following table gives the yield calculated per acre:

	Yield per acre, lbs. Oats.	 Straw.
Plat A	1,617	2,117
Plat B	1,875	2,267
Plat D	1,772	2,147
Plat E	1,895	2,132
Average	1,789	2,166

From these averages, and the averages of the table showing ash constituents of the oats, and analyses* of the straw, we have the following amounts per acre in pounds:

	Oats.	Straw.	Total.
Phosphoric acid P_2O_5	10.8	1.0	11.8
Potash K_2	8.9	29.2	38.1
Lime CaO	1.8	9.7	11.5
Magnesia MgO	1.8	1.0	2.8
Nitrogen N	38.4	8.2	46.6

INCREASE IN CORN FOR THE SILO AS IT APPROACHES MATURITY.

How much increase is there in a crop of corn for the silo during the latter period of its growth? To answer this question and to learn something of the nature of the chemical changes which take place, a field of Burrell and Whitman corn, intended for the silo, was divided into two parts; each alternate set of four rows was cut September 11, and the remaining portion allowed to stand until a later date. There was a little less than two acres in the field, but we give the results calculated per acre as being more convenient. The corn as fast as cut was placed upon wagons and drawn to the barn, where it was weighed and then at once cut into the silo. By dividing the field into sets of four rows each we were able to secure more uniform conditions than would otherwise be possible, besides giving the remaining corn a better chance to grow. Several samples were taken from different parts of the field and brought to the laboratory and the water content determined. Later an analysis was made to find the chemical composition of the dry matter. At this date, September 11, the corn varied from full silk to the watery stage of the kernels.

September 29, from fear of threatening frosts, the remaining corn was cut, weighed and sampled for analysis, and a silo adjoining the first filled. When the silos are opened samples of

	Lbs.
September 11, corn per acre	25,326
September 29, corn per acre	25,011

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* Sixth Annual Report New York Agricultural Experiment Station, p. 431.

the silage will be taken for analysis and thus furnish us some information as to the changes which have taken place in the two lots in the silo. Although the last corn was allowed to stand 18 days longer than the first, yet the total weight per acre was 315 pounds less than on September 11, but if we consider the amount of water then the dry matter shows in favor of the last cutting by 656 pounds. In the ash we find there was a gain of 22 pounds, but the main increase comes upon the nitrogen-free extract, there being an increase of 413 pounds. The nitrogen made no gain, there being found less by three pounds in the last cutting than there was September 11, but this is a difference of less than one-tenth of one per cent in the dry substance so we may feel warranted in saying there was no increase in the albuminoids of our crop from September 11 to September 29, the principal increase being in the starchy matter of the fodder.

	Per cent.
September 11, water in corn	80.52
September 29, water in corn	77.37

Per acre.	Sept. 11, lbs.	Sept. 29. lbs.
Dry matter	5,004	5,660
Ash	215	237
Albuminoids	525	512
Crude fiber	1,443	1,650
Nitrogen-free extract	2,696	3,109
Fat	125	188

HAYS FROM DIFFERENT LOCALITIES.

I have already pointed out a difference in the chemical composition of timothy hays from different parts of the country,* and the present year the examination of the hays from Wisconsin, Maine, New Hampshire and New York grown in the same places as those of the previous year has been continued. For these samples I am indebted to Dr. S. M. Babcock, of the Agricultural Experiment Station at the University of Wisconsin; to Professor W. H. Jordan, of the Maine Experiment Station, and to Professor G. H. Witcher, of the New Hampshire Experiment Station.

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* Sixth Annual Report of New York Agricultural Experiment Station, p. 417.

The samples at this Station were grown upon the same plats as for the previous years, and were cut at period of full bloom.

A summary of the analyses for the several years is given below:

TIMOTHY.	Ash.	Albuminoids, N × 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Wisconsin. 1886	6.36	8.75	38.85	42.40	3.62
Wisconsin, 1887	6.76	7.25	35.66	47.14	3.19
Maine, 1885	5.24	7.56	36.22	48.20	2.78
Maine, 1886	4.01	5.81	35.45	52.01	2.72
Maine, 1887	5.10	8.62	33.92	49.34	3.02
Maine, 1887 (past bloom)	5.39	7.69	33.74	50.07	3.11
New Hampshire, 1887	3.47	8.00	40.27	46.23	2.03
New Hampshire, 1887	4.17	8.00	40.09	45.31	2.43
New York Station, 1886	4.75	4.69	29.88	57.75	2.93
New York Station, 1887	5.54	8.12	30.65	52.62	3.07
New York Station, 1888	4.45	6.12	30.95	55.09	3.39

As yet our table is not sufficiently complete to enable us to make any comparative study of the hays from the different parts of the country, but one thing we may note, that the variation in the composition of the hays from different localities is quite marked for different years, and shows what has already been pointed out, that often the meteorological influences are a more potent factor in determining the quality (not the quantity) of a hay crop than are the fertilizers. These influences are largely beyond the control of man, yet by proper cultivation of the soil, drainage, etc., much may be done to bring certain of these forces under our control.

The digestibility of the albuminoids of the hay was determined by artificial digestion and is shown in the following:

	Per cent albuminoids digested.
Wisconsin, 1886	67.39
Maine, 1885	62.53
Maine, 1886	54.80
New Hampshire, 1887	54.75
New Hampshire, 1887	64.12
New York Station, 1886	56.08
New York Station, 1887	59.97
New York Station, 1888	60.11

Partial ash analyses were made, and when calculated upon the dry substance of the hay, we have as follows:

TIMOTHIES.	Phosphoric acid, P_2O_5.	Potash, K_2O.	Nitrogen, N.
Wisconsin, 1886	0.327	1.593	1.40
Wisconsin, 1887	0.607	1.306	1.16
Maine, 1885	0.232	0.834	1.21
Maine, 1886	0.246	0.728	0.93
Maine, 1887	0.723	1.292	1.38
New York Station, 1886	0.179	1.097	0.75
New York Station, 1887	0.385	1.702	1.30
New York Station, 1888	0.313	1.459	0.98

In connection with our other studies of grasses this question of variation for different localities will be continued, and in time we trust that the several studies which now are fragmentary may all be brought together into one general and complete whole.

NITROGEN-FREE EXTRACT OF FODDERS.

he nitrogen-free extract of feeding-stuffs is a mixture of sugars, starch, pectic and mucilaginous substances with organic acids, gums, etc. Analysts have been in the habit of determining all the other constituents of a fodder and taking the nitrogen-free extract by difference. That is, the sum of all the other substances when subtracted from 100 gave the nitrogen-free extract. It would be far better to determine the amount of the sugars and starch and take the remainder by difference, even doing away, if necessary, with the determination of the crude fiber. The amount of sugar and starch varies in different fodders, even in the same fodder at different periods of maturity and for the same fodder grown under different conditions. Twenty-one samples of timothy, all cut at period of full bloom, varied in their sugar and starch content as follows:

	Invert sugar.	Sucrose.	Starch.
Maximum	5.00	7.60	22.61
Minimum	2.32	4.68	17.55

Other things being the same, it is evident that the timothy having the largest per cent of sugars and starch is the most valuable for feeding, and to find just how great was the differences in the various feeding stuffs we have made determination of these in several of our most common foods. This work was begun nearly two years ago, and in the last annual report is given, in connection with the other analyses, the per cent of sugars and starch in a few foods. These, with others that have been completed, are brought together to show the variation, and not only is there a difference in amount, but the starches of different foods possess different properties I believe chemical as well as physical. At least those products which we determine as starch in various

SUGARS AND STARCH IN FOODS.

SUBSTANCES.	Invert sugar.	Sucrose.	Starch.	Per cent of nitrogen-free extract as sugar and st'ch
Timothy (average 21), 1887	2.23	6.21	19.72	55.69
Timothy (average 8), 1888	5.68	4.54	24.20	69.24
Timothy (late cut)	2.31	4.87	22.31	57.07
Red clover (average 21)	3.88	2.48	9.38	35.40
Ray grass (average 4)	3.76	4.74	19.14	....
Alsike clover*	....	....	14.63	33.81
Wheat straw	....	....	22.42	59.52
Oat straw	....	....	23.18	51.14
Sorghum (fodder)	17.60	3.40	12.19	64.21
Fodder maize	9.00	.40	13.87	53.48
Maize stover	2.50	1.43	22.88	53.32
Oats	....	....	53.20	81.05
Wheat	1.64	2.36	57.91	76.37
Flour	3.64	8.36	61.88	86.77
Corn meal	....	... .	71.97	88.69
Wheat bran	1.60	4.40	45.60	83.53
Wheat middlings	3.20	6.40	41.44	75.31
Shipstuff	2.08	5.92	41.46	83.07

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* In a few the whole are calculated as starch, no determination of the sugar having been made.

feeding-stuffs differ, for if we treat grain with diastase we convert nearly as much of the starchy matters into sugar as when they are treated with acid, but an attempt to apply this method to hays fails, although acid will invert about 20 per cent in timothy. We may by similar treatment show differences in many of those starchy products in the different foods, and I believe there exists a variation and gradation in the starches, as they occur in plants, no less marked than in the case with the nitrogenous products which we have already been able to separate into true albuminoids, amides, amide acids, etc. These various gradations of starch may be found to have different feeding values, and thus enable us to explain certain differences, even though these variations be slight.

THE FATS.

The oils of different plants and parts of plants are possessed of quite different properties, chemical and otherwise, and although considered of like value for feeding, yet their effect is well known to be quite different. Pure American lard is said to be quite different from that produced in England, and hogs fattened on masts furnish a soft oily lard quite different from corn fed hogs, showing the influence of the food on the animal products; and again, as reported elsewhere, cows fed on linseed meal gave a milk from which the butter was found to possess properties very different from the butter of the same cows when fed corn or wheat bran as their grain feed. In Holland this influence of the food on the butter is carefully noted, and it is said that the difference between butter made under feed of palm nut cake and linseed meal is very marked, in the one case, being firm, hard and waxy,

VARIATION IN OILS OF FEEDING-STUFF.

OILS.	Iodine number.	Koettstorfer's test, millograms of KOH for 1 gram. oil.
Corn oil	102.6	209.7
Cottonseed oil	89.7	200.4
Cottonseed oil	114.7	199.9
Wheat-bran oil	136.0	178.0
Oat oil	106.6	181.1
Timothy hay oil	102.1	133.9

while in the other it is soft and oily. It is true this difference is probably not wholly due to difference in the oil of the foods, but I believe much of the difference may be attributed to this. I do not mean to be understood as saying that difference in food will make a good butter cow from an inferior animal, but rather that improper food fed to a good cow will result in an inferior quality of butter.

FEEDING EXPERIMENTS.

JEM AND MEG.

During the winter of 1887–8 two cows, Jem and Meg, were fed in the experimental barn from December 20 to February 10, the hay fed being from the same general lot of orchard grass hay in good condition; the first period being hay alone; the second period hay and eight pounds of corn meal; the third period hay, two pounds of corn meal and five pounds of linseed meal, and the fourth period hay, two pounds corn meal and eight pounds wheat bran. The animals were weighed each morning before receiving food or drink. Their feed and water were weighed out to them and all refuse weighed back on the following morning. A record of the milk yield was kept, and analyses of the milk from each cow made so far as our laboratory force would permit. The milk of the two cows was mixed and creamed by the Cooley process for butter, and the salted and weighed butter was carefully sampled and analyzed so that the round of data has been quite complete.

Digestion experiments during the first and second periods were carried out for determining the digestibility of orchard grass hay and of corn meal, or of a ration of corn meal and orchard grass hay.

The cow Jem was seven and a half years old and dropped her last calf February 1, 1887, and was due in calf again in March. Meg, nine years old, dropped her last calf June 25, 1887, and was going farrow at time of experiment.

The large mass of data as tabular matter makes it seem best to give first the tables, and to reserve all discussion of results for the appropriate place further along.

UNDER ORCHARD GRASS HAY FEED.

DATE.	LIVE WEIGHT, LBS.		FOOD CONSUMED, LBS.				WATER DRUNK, LBS.		MILK YIELD. LBS.	
			HAY.		CORN MEAL.					
	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.
Dec. 20	882	878	19.	18.4	....	....	72.6	56.1	10.8	11.9
21	870	883	19.	17.1	....	....	42.5	53.6	9.4	10.9
22	863	871	21.	18.1	....	....	75.5	79.5	9.9	10.1
23	879	867	21.	18.2	....	....	61.8	56.5	9.1	10.2
24	873	867	21.	18.5	....	....	57.	30.3	9.	9,2
25	873	866	19.9	19.	....	....	48.8	63.6	8.2	10.6
26	887	865	18.	19.	....	....	53.9	61.8	6.8	9.5
27	873	865	18.5	18.9	....	....	63.9	59.5	6.5	10.2
28	880	865	20.6	18.2	....	....	66.6	58.4	7.5	9.5
29	888	861	18.8	18.1	....	....	26.1	41.8	6.7	9.5
Av. for 10 days.	876	868	19.7	18.3	....	....	56.8	56.1	8.4	10.2

UNDER HAY AND CORN MEAL FEED.

Dec. 30	860	851	18.	17.8	4	4	41.1	68.1	6.6	9.2
31	845	865	19.4	17.8	4	4	65.5	60.6	6.2	9.6
Jan. 1	864	865	18.1	18.3	6	6	48.1	52.2	6.1	9.1
2	868	858	17.6	17.4	6.5	6.5	83.6	73.5	7.6	10.8
3	892	871	17.0	16.2	8	8	52.1	60.1	8.3	11.0
4	896	867	17.8	17.6	8	8	43.8	66.9	8.8	11,3
5	890	882	17.5	15.8	8	8	52.8	48.2	9.2	11.8
6	886	863	17.8	16.5	8	8	67.1	59.0	9.5	11.9
7	893	871	17.9	17.7	8	8	47.0	70.4	9.5	11.3
8	881	880	17.9	17.5	8	8	65.5	64.7	9.0	11.9
9	889	881	17.9	17.5	8	8	68.5	62.8	10.1	11.2
10	895	873	17.8	16.3	8	8	74.9	76.4	10.3	11.8
11	889	872	17.9	17.5	8	8	68.9	75.4	10.3	12.0
12	889	876	17.9	17.6	8	8	64.8	64.0	10.5	12.5
Av. for 10 days.	890	874	17.7	17.0	8	8	60.5	64.8	9.5	11.7

Under Hay, Corn Meal and Linseed Meal Feed.

DATE.	Live Weight, lbs.		Food Consumed, lbs.						Water Drunk, lbs.		Milk Yield, lbs.	
			Hay.		Corn Meal.		Linseed Meal.					
	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.
January 13.......	884	868	17.8	17.7	6	6	1.	1.	63.5	72.2	10.0	12.4
14.......	887	875	17.9	17.8	4	4	3.5	3.5	74.0	61.8	10.8	12.1
15.......	890	865	17.9	17.8	2	2	5.	5.	52.7	71.7	9.8	11.5
16.......	880	862	17.9	17.9	2	2	5.	5.	56.7	72.8	10.0	11.2
17.......	882	874	18.8	18.7	2	2	5.	5.	61.8	62.0	9.8	11.5
18.......	882	867	19.8	19.9	2	2	5.	5.	43.5	77.6	9.8	11.2
19.......	875	883	22.8	21.4	2	2	5.	5.	103.2	78.2	9.7	11.6
20.......	925	891	20.0	19.8	2	2	5.	5.	54.5	68.7	10.1	11.5
21.......	914	892	17.6	19.1	2	2	5.	5.	69.2	81.6	9.6	11.9
22.......	917	887	19.5	19.7	2	2	5.	5.	21.1	79.4	9.0	10.9
23.......	875	883	21.8	20.8	2	2	5.	5.	85.5	50.1	9.4	11.1
24.......	919	889	23.6	22.3	2	2	5.	5.	71.9	68.1	9.6	11.4
25.......	926	890	21.4	20.1	2	2	5.	5.	64.9	81.1	9.3	11.3
Av. for 10 days.	899	882	20.1	20.0	2	2	5.	5.	63.7	71.9	9.6	11.3

UNDER HAY, CORN MEAL AND WHEAT-BRAN FEED.

DATE.	LIVE WEIGHT, LBS.		FOOD CONSUMED, LBS.						WATER DRUNK, LBS.		MILK YIELD, LBS.	
			HAY.		CORN MEAL.		WHEAT-BRAN.					
	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.
January 26	920	899	19.6	17.6	2	2	8	8.	68.0	47.6	9.4	8.5
27	924	878	17.8	16.1	2	2	13	13.	77.0	93.1	9.0	12.6
28	936	904	14.0	14.9	2	2	13	7.5	73.7	59.5	8.7	8.9
29	937	900	19.8	13.0	2	2	6	1.5	61.8	48.2	8.9	8.0
30	923	896	19.9	18.7	2	2	8	8.	82.1	67.5	10.5	8.2
31	933	895	18.5	15.6	2	2	8	8.	71.1	79.8	9.5	9.8
February 1	922	887	18.3	16.1	2	2	8	8.	56.2	87.5	8.5	9.8
2	902	885	19.9	18.5	2	2	8	8.	50.1	80.3	8.6	10.8
3	884	890	20.0	15.0	2	2	8	8.	104.4	64.4	8.6	10.9
4	932	892	20.1	19.6	2	2	8	8.	83.6	88.4	9.0	11.3
5	938	904	19.5	19.6	2	2	8	8.	83.0	78.1	8.9	11.9
6	959	905	16.8	16.4	2	2	8	8.	58.0	63.0	8.6	11.0
7	939	905	16.9	18.0	2	2	8	8.	70.8	79.5	8.5	13.2
8	952	912	17.9	17.9	2	2	8	8.	32.6	72.1	7.8	13.4
9	924	912	20.0	18.8	2	2	8	8.	64.3	102.6	7.5	11.0
Av. for 10 days.	928	899	18.8	17.6	2	2	8	8.	67.4	79.6	8.6	11.3

Each period of feeding for digestion experiment was for ten days, the dung being saved the last four. A man remained with the cows constantly for four days and nights, the urine and dung being received in pails and kept in closed vessels, and thoroughly mixed and sampled each morning. Since the results are only affected to the fractional part of a per cent, whether we calculate our results upon the feed of the ten days or upon the four days while the excrement was saved or analyzed, we tabulate the figures for the four days only.

The following is the average composition of the hay fed during the trials:

	Per cent.
Water	14.65
Dry matter	85.35

Dry Matter.	Per cent.
Ash	6.33
Albuminoids	9.69
Crude fiber	39.32
Nitrogen-free extract	40.91
Fat (ether extract)	3.75

The amount of water in the unconsumed hay varied considerably different days, and the calculations were made independently each day, but the average during the period was as follows:

	Jem.	Meg.
Water	22.32	29.01
Dry matter	77.68	70.99

Dry Matter.	
Ash	6.05
Albuminoids	7.31
Crude fiber	39.29
Nitrogen-free extract	44.47
Fat (ether extract)	2.87

The corn meal used in the second experiment had the following composition:

	Per cent.
Water	18.45
Dry matter	81.55

Dry Matter.	
Ash	1.39
Albuminoids	11.75
Crude fiber	1.83
Nitrogen-free extract	80.46
Fat (ether extract)	4.57

The amount of excrement each day is shown below for the trial with orchard-grass hay:

	SOLID EXCREMENT.				URINE.			
	Jem.		Meg.		Jem.		Meg.	
	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.
December 26	46	1	41	1	13	12	16	2
December 27	35	1	33	1	13	14	17	0
December 28	41	6	36	15	17	5	21	8
December 29	40	12	38	1	22	9	11	9
Average	40	13	37	4	16	14	16	9

For the trial under orchard-grass hay and corn meal the results were as follows:

	SOLID EXCREMENT.				URINE.			
	Jem.		Meg.		Jem.		Meg.	
	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.
January 10	38	12	45	8	16	11	19	0
January 11	49	3	53	6	19	5	13	11
January 12	47	8	48	10	16	6	14	12
January 13	41	3	42	14	7	8	9	8
Average	44	2	47	9	14	15	14	4

The composition of dung varied quite a considerable for the different days, and the following table gives the average of duplicate determinations for each day:

UNDER ORCHARD-GRASS HAY FEED.

DATE.	Cow.	Water.	DRY SUBSTANCE.				
			Ash.	Albuminoids, N × 6.25.	Crude fiber.	Nitrogen-free extract.	Fat (ether extract).
December 26	Jem	89.55	9.27	9.75	32.46	44.01	4.51
	Meg	81.91	8.01	11.22	35.96	42.45	4.14
December 27	Jem	86.44	9.49	10.94	31.74	43.03	4.80
	Meg	81.71	7.98	8.77	36.02	43.00	3.94
December 28	Jem	82.71	8.88	10.12	34.39	43.07	3.54
	Meg	82.49	8.06	9.78	35.53	43.20	3.77
December 29	Jem	81.34	7.93	9.06	35.36	43.81	3.84
	Meg	82.07	7.67	9.77	36.65	42.89	3.85
Average	Jem	85.01	8.89	9.97	33.48	43.49	4.17
	Meg	82.04	7.94	9.88	36.04	42.22	3.92

Under orchard-grass hay and corn meal feed the composition of the solid excrement was as follows:

DATE.	Cow.	Water.	DRY SUBSTANCE.				
			Ash.	Albuminoids, N × 6.25.	Crude fiber.	Nitrogen-free extract.	Fat (ether extract.)
January 10	Jem	82.26	6.92	11.87	32.03	45.15	4.03
	Meg	83.95	7.14	11.19	33.79	44.58	3.30
11	Jem	82.76	7.68	11.56	33.13	44.00	3.63
	Meg	84.21	7.23	10.62	32.28	45.31	3.56
12	Jem	83.40	6.96	12.56	33.03	43.82	3.63
	Meg	84.69	7.42	11.12	35.55	42.56	3.35
13	Jem	82.50	7.49	12.44	31.90	44.57	3.60
	Meg	83.97	6.97	11.25	33.29	44.99	3.50
Average	Jem	82.73	7.26	12.10	32.55	44.37	3.72
	Meg	84.20	7.19	11.04	33.72	44.62	3.43

DIGESTIBILITY OF ORCHARD-GRASS HAY AND CORN MEAL.

ORCHARD-GRASS HAY.

The analysis of the feeds, unconsumed hay and dung, together with the other necessary data, having been given, we here, to prevent multiplicity of figures to confusion, give only the general average for the trials with the two cows. We may again state that, in the first trial, although the cows were fed more hay than was consumed, yet for the whole period there was a slight loss of nitrogen from the body, more being recovered in the excrements, including the milk, than was contained in the hay eaten. In the case of Jem the loss of nitrogen was greater than with Meg, due undoubtedly to the needs for the fœtus.

AVERAGE AMOUNTS PER DAY, IN OUNCES.

	DRY MATTER.		ALBUMINOIDS.		CRUDE FIBER.		NITROGEN-FREE EXTRACT.		FAT (ETHER EXTRACT).	
	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.
Hay fed	267.73	260.72	25.94	25.28	107.77	100.01	109.53	106.66	10.04	9.79
Waste	17.48	8.82	1.26	0.64	6.79	3.46	7.66	3.92	.49	.25
Amount consumed	250.25	251.90	24.68	24.64	100.98	96.55	101.87	102.74	9.55	9.55

From the previous tables we take the average amounts per day of these various constituents contained in the dry dung, and by a simple calculation determine the digestibility of orchard-grass hay, as presented in the following table:

	DRY MATTER.		ALBUMINOIDS.		CRUDE FIBER.		NITROGEN-FREE EXTRACT.		FAT (ETHER EXTRACT).	
	Jem.	Meg.	Jem,	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.
Total feed	250.25	251.90	24.68	24.64	100.98	96.55	101.87	102.74	9.55	9.54
Dung	100.03	107.14	9.86	9.64	32.60	38.57	43.50	45.93	4.07	4.25
	150.22	144.76	14.82	15.00	67.38	57.98	58.37	56.81	5.48	5.29
Per cent digested	60.02	57.46	60.06	60.89	66.72	60.05	57.29	55.29	57.42	55.41
Av. per cent digested	58.74		60.47		63.48		56.29		56.41	

An inspection of the previous table shows that the sample of orchard-grass hay used in these experiments was fully as digestible as timothy or any of our best upland hay. By chemical analysis, which gives us the potential and not the nutritive value of a fodder, it has proven itself for the past two years a more highly nitrogenous hay than timothy. A further study of the feeding value of the hay will appear under the topic, "Influence of Food upon the Milk and Butter."

ORCHARD-GRASS HAY AND CORN MEAL FEED.

As previously stated, during the second digestion experiment there was fed to each cow eight pounds of corn meal per day and a known quantity of hay, as shown in the previous tables.

The details for the entire experiment having already been given in former pages of this report, we need here only present a summary of the results showing the digestibility of the ration and of the corn meal in the ration. In this we assume, for the present, that the digestibility of the orchard grass hay was the same in the ration that it was when fed alone:

AVERAGE AMOUNTS PER DAY, IN OUNCES.

	DRY MATTER.		ALBUMINOIDS.		CRUDE FIBER.		NITROGEN-FREE EXTRACT.		FAT (ETHER EXTRACT).	
	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.
Hay..................	245.908	245.908	23.828	23.828	96.691	96.691	100.601	100.601	9.221	9.221
Waste...............	1.937	9.544	.141	.698	.761	3.739	.861	4.244	.056	.274
	243.971	236.364	23.687	23.130	95.930	92.952	99.740	96.357	9.165	8.949
Corn meal..........	104.384	104.384	12.265	12.265	1.910	1.910	83.987	83.987	4.770	4.770
Amount consum'd	348.355	340.748	35.952	35.395	97.840	94.862	183.727	180.344	13.935	13.719

From data already presented we have the average amounts per day of these various constituents in the dung, and in the following table are presented the digestion coefficients for the components of the ration:

ORCHARD-GRASS HAY AND CORN MEAL, IN OUNCES.

	DRY MATTER.		ALBUMINOIDS.		CRUDE FIBER.		NITROGEN-FREE EXTRACT.		FAT (ETHER EXTRACT).	
	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.
Total feed	348.355	340.748	35.952	35.395	97.840	94.862	183.727	180.344	13.935	13.719
Dung	121.862	117.741	14.742	12.993	39.683	40.012	54.042	52.227	4.522	4.038
Digested............	226.493	223.007	21.210	22.402	58.157	54.850	129.685	128.117	9.413	9.681
Per cent digested	65.01	65.44	58.99	63.29	59.44	57.81	70.59	71.03	67.55	70.56
Average	65.23		61.14		58.63		70.81		69.05	

The results of this trial are somewhat of a surprise, since the per cent of albuminoids digested in this ration is but little higher than for the hay alone, while with the crude fiber the digestion coefficient is nearly six per cent lower than was the case with the hay. Why this difference? In the case of the albuminoids there are two directions in which we may look to find a cause. First, that in the previous trial the feed eaten proved to be less than a maintenance ration, as has already been shown, although the animals were offered more hay than they consumed, this being the case they might digest a larger per cent than where more was eaten than necessary for the maintenance of the animal as in the second case. On the other hand, these cows were fed the corn meal separate from the hay, and it is claimed by some that under such feeding the meal will not be as fully digested as when it is fed mixed with the hay. The reason given for this is that much of the meal passes at once into the fourth stomach or *abomasum*, and not being remasticated, as is the coarse fodders, it is not so fully digested. But this assumption, which, if correct, might be true for the albuminoids, does not explain the depression of digestibility for the fiber, since the small amount of fiber contained in the corn meal would not give the difference shown by the two trials. The question as to whether the ground feeds shall be fed mixed with the hay, or whether each can be fed separately with as good results, is one of great practical importance in feeding, and in future feeding experiments we hope to be able to help throw some light upon this question.

CORN MEAL.

If we assume the digestibility for the hay in the ration to be the same as when fed alone, then we have the necessary data for calculating the digestibility of the corn meal. In the following table we have given the figures obtained by calculation from the previous data:

	DRY MATTER.		ALBUMINOIDS.		CRUDE FIBER.		NITROGEN-FREE EXTRACT.		FAT (ETHER EXTRACT).	
	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.
Amount digested, ozs....	226.493	233.007	21.210	22.402	58.157	54.850	129.685	128.117	9.413	9.681
Digested from hay, ozs...	135.941	136.815	14.226	14.084	64.003	55.817	57.141	53,276	5.265	4.958
Dig. from corn m'l, oz.	90.552	86.192	6.984	7.318	......	......	72.544	74.841	4.148	4.623
Per cent digested........	86.75	82.57	56.94	59.66	......	......	85.18	89.11	86.99	96.91
Average..............	84.66		58.35		....		7.14		91.	

THE AMOUNT OF NITROGEN SUPPLIED AND RECOVERED.

In order that we may know whether the animals were eating a maintenance ration or not, we may first consider the absolute amount of nitrogen consumed during the period of four days and that recovered in the dung, urine and milk for the same time. As the previous feeding of the two cows had been the same for several days preceding the trial, there can be little error from the amount of food consumed. As previously stated, they were fed what orchard-grass hay they would consume, and in the second trial there was also fed eight pounds of corn meal in addition to the hay.

During the first experiment under orchard-grass hay feed there was consumed of nitrogen the following amounts, expressed in ounces:

	Jem.	Meg.
Total nitrogen	15.792	15.9780
Average per day	3.948	3.9945

There was recovered of nitrogen the following amount, as determined by analysis:

JEM.	Total.	Average per day.
Nitrogen in dung	6.3100	1.5775
Nitrogen in urine	7.3684	1.8421
Nitrogen in milk	3.1368	0.7842
	16.8152	4.2039

MEG.	Total.	Average per day.
Nitrogen in dung	6.3260	1.5815
Nitrogen in urine	5.9134	1.4783
Nitrogen in milk	4.0968	1.0242
	16.3362	4.0840

For the second experiment of four days expressed in the same manner we have the following amounts under hay and corn meal feed:

	Jem, ozs.	Meg, ozs.
Total nitrogen	23.008	22.500
Average per day	5.752	5.625

The amounts recovered in the dung, urine and milk were as below:

JEM.	Total oz.	Average per day, oz.
Nitrogen in dung	9.4364	2.3591
Nitrogen in urine	5.2628	1.3132
Nitrogen in milk	4.6696	1.1674
	19.2688	4.8397

MEG.	Total, oz.	Average per day, oz.
Nitrogen in dung	9.3269	2.3319
Nitrogen in urine	5.6842	1.4210
Nitrogen in milk	5.4420	1.3600
	20.4531	5.1129

In the first experiment we find more nitrogen recovered than was fed, the larger loss being in the case of Jem, with an extra demand made to supply the growth of her fœtus. In the second period there was stored up considerable nitrogen by both animals, showing that they were receiving more than a maintenance ration.

AMOUNT OF DUNG AND FERTILIZING MATTER CONTAINED IN THE SAME, VOIDED BY COWS.

The digestion experiment conducted with the two cows, Jem and Meg, gave an opportunity for determining the amount of dung, and the composition of the same, voided by these animals under orchard-grass hay, and under orchard-grass hay and corn meal feed. The average weights of the cows for each period were:

	First period, lbs.	Second period, lbs.
Jem	876	890
Meg	868	874

The amount of dung voided per day, expressed in pounds, is shown by the following table:

	Period.	Total dung.	Water in dung.	Dry matter.
Jem	I	40.8	34.5	6.3
Jem	II	44.2	36.8	7.4
Meg	I	37.3	31.6	5.7
Meg	II	47.6	40.2	7.4

The amount of dung per day was considerably greater under hay and corn meal than with hay alone.

In order to bring out the relation more clearly for comparison, we recalculate our figures for animals of 1,000 pounds live weight.

	Period.	Total dung, lbs.	Water in dung, lbs.	Dry matter, lbs.
Jem	I.	46.5	39.4	7.1
	II.	49.6	41.3	8.3
Meg	I.	42.9	36.4	6.5
	II.	54.4	45.9	8.5

The average composition of the dung under each period was as follows for the dry substance:

	PERIOD.	
	I.	II.
	Per cent.	Per cent.
Nitrogen, N	1.53	1.85
Phosphoric acid, P_2O_5	.65	.78
Potash, K_2O	1.30	1.08
Lime, Ca. O	1.21	1.04
Magnesia, Mg. O	0.04	.33

Calculating the amount of dung for a cow of 1,000 pounds live weight, both the fresh and dry substance, we have the following averages expressed in pounds:

	PERIOD.			
	I.		II.	
	Fresh.	Dry.	Fresh.	Dry.
Per day	44.7	6.8	52.0	8.4
For one hundred days	4470.0	680.0	5200.0	840.0
For one year	16315.5	2482.0	18980.0	3066.0

From the data already given, we may determine the amount in pounds of the various fertilizing elements contained in the manure for 100 days, also for one year:

	PERIOD.			
	I.		II.	
	100 days.	One year.	100 days.	One year.
Nitrogen, N	10.40	27.97	15.54	56.72
Phosphoric acid, P_2O_5	4.42	16.13	6.55	23.91
Potash, K_2O	8.84	32.26	9.07	33.11
Lime, CaO	8.23	30.03	8.73	31.88

To furnish an amount of fertilizing matter equivalent to that contained in the dung for 100 days and for one year, also under the different feeds, would require as follows:

	PERIOD.			
	I.		II.	
	100 days.	One year.	100 days.	One year.
	Lbs.	Lbs.	Lbs.	Lbs.
Ammonium sulphate	52	189	77	289
Phosphate rock	31	115	47	171
Potassium sulphate	37	136	39	144

THE URINE.

The amount of urine per day from each cow during these experiments is given in the following, expressed as pounds:

	Period.	
	I.	II.
Jem	16.9	14.9
Meg	14.9	14.3
Average	15.9	14.6

As with the dung, calculating these figures for animals weighing 1,000 pounds, we have for comparison the pounds of urine per day, as follows:

	Period.	
	I.	II.
Jem	19.3	17.1
Meg	16.8	16.3
Average	18.0	16.7

The average per cent of nitrogen for each period was as below:

Period.	Per cent.
I	0.63
II	0.59

We may now, from the previous data, calculate the total amount of nitrogen contained in the urine, as follows:

	Period.	
	I. lbs.	II. lbs.
Per day	0.103	0.101
For 100 days	10.340	10.133

The amount of nitrogen in the urine during the first period was almost exactly that contained in the dung, but for the second period there was nearly five pounds more in the dung than in the urine for the same time (100 days). The large amount of chemical work necessary to be accomplished in connection with this experiment at the time prevented our making further examination of the urine. Enough is given to show the large loss resulting from the neglect to save the urine of our animals, since when those animals were fed on hay alone the amount of nitrogen contained in the urine was almost as great as that in the solid dung. More than this, the nitrogen of the urine is all in a soluble form, while much of that of the dung is locked up, as it were, until the mass is decomposed.

INFLUENCE OF FOOD ON MILK AND BUTTER.

Two series of feeding experiments were made during the winter of 1887–8, in connection with other experiments, to learn something of the influence of certain foods upon the milk and butter. The first trial was a continuation of the digestion experiment with Jem and Meg, and later a second series was made with two native cows, Ceres and Juno. Meg was going farrow and Jem soon due in calf, while both Ceres and Juno were fresh in milk at the beginning of the trial. The trial with Juno was in no way satisfactory, as in the last two periods she refused to eat either linseed meal or wheat bran.

The mass of detail tabular matter is unessential to the best understanding of the results, so only the averages for the last portion of each period are given.

The amount of food consumed per day for the last ten days of each period is given in the following table:

FOOD PER DAY FOR JEM AND MEG.

PERIOD.	HAY, LBS.		CORN MEAL, LBS.		LINSEED MEAL, LBS.		WHEAT BRAN, LBS.	
	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.
1	19.7	18.3	......	......	......	......	......	......
2	17.7	17.0	8	8	......	......	......	......
3	20.1	20.0	2	2	5	5	......	......
4	18.8	17.6	2	2	......	......	8	8

AVERAGE FEED PER DAY FOR CERES AND JUNO.

PERIOD.	HAY, LBS.		CORN MEAL, LBS.		LINSEED MEAL, LBS.		WHEAT BRAN, LBS.	
	Ceres.	Juno.	Ceres.	Juno.	Ceres.	Juno.	Ceres.	Juno.
2	15.0	9.3	8	10	......	......	......	......
3	19.0	13.8	2	2	5	......	......	......
4	16.1	10.7	2	2	......	......	8	......

Juno in period 3 and 4 refused to eat but a small part of her linseed meal or wheat bran, and the exact amount is not known.

The hay fed Jem and Meg was orchard-grass hay, while that fed Ceres and Juno was mixed grasses containing considerable clover. The average amounts of the several nutrients eaten per day for the last ten days of the several periods is shown by the accompanying tables. The analytical data is given in the tables of analysis Nos. 2032, 2045, 2088, 2112, 2203 and 2235. We give first the amounts for Jem and Meg:

FIRST PERIOD.

	ASH.		ALBUMINOIDS, N. × 6.25.		CRUDE FIBER.		NITROGEN-FREE EXTRACT.		FAT.	
	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.
Hay	1.08	1.00	1.65	1.53	6.72	6.24	6.03	6.53	.64	.60
SECOND PERIOD.										
Hay	.97	.93	1.48	1.42	6.04	5.80	6.31	6.06	.57	.55
Corn meal	.09	.09	.76	.76	.12	.12	5.21	5.21	.29	.29
Total	1.06	1.02	2.24	2.18	6.16	5.92	11.52	11.27	.86	.84
THIRD PERIOD.										
Hay	1.10	1.10	1.68	1.67	6.86	6.82	7.17	7.14	.65	.65
Corn meal	.02	.02	.19	.19	.03	.03	1.30	1.30	.07	.07
Linseed meal	.23	.23	1.78	1.78	.59	.59	1.41	1.41	.42	.42
Total	1.35	1.35	3.65	3.64	7.48	7.44	9.88	9.85	1.14	1.14
FOURTH PERIOD.										
Hay	1.03	.97	1.57	1.47	6.42	5.91	6.71	6.28	.61	.57
Corn meal	.02	.02	.19	.19	.03	.03	1.30	1.30	.07	.07
Wheat bran	.45	.45	1.37	1.37	.68	.68	3.63	3.63	.32	.32
Total	1.50	1.44	3.13	3.03	7.13	6.62	11.64	11.21	1.00	.96

The amounts of the several nutrients eaten per day by Ceres and Juno is shown by the following table. In this series the hay period is omitted:

	ASH.		ALBUMINOIDS, N. × 6.25.		CRUDE FIBER.		NITROGEN-FREE EXTRACT.		FAT.	
	Ceres.	Juno.	Ceres.	Juno.	Ceres.	Juno.	Ceres.	Juno.	Ceres.	Juno.
SECOND PERIOD.										
Hay	.74	.46	.95	.59	4.13	2.56	6.55	4.06	.37	.23
Corn meal	.09	.11	.76	.95	.12	.15	5.21	6.51	.29	.37
Total	.83	.57	1.71	1.54	4.25	5.71	11.76	10.57	.66	.60
THIRD PERIOD.										
Hay	.94	.68	1.21	.88	5.23	3.80	8.29	6.02	.47	.34
Corn meal	.02	.02	.19	.19	.03	.03	1.30	1.30	.07	.07
Linseed meal	.23	....	1.78	....	.59	....	1.41	....	.42	....
Total	1.19	....	3.18	....	5.85	....	11.00	....	.96	....
FOURTH PERIOD.										
Hay	.80	.53	1.03	.68	4.43	2.95	7.03	4.67	.40	.27
Corn meal	.02	.02	.19	.19	.03	.03	1.30	1.30	.07	.07
Wheat bran	.45	....	1.37	....	.68	....	3.63	....	.32	....
Total	1.27	....	2.59	....	5.14	....	11.96	....	.79	....

In the following tables are given the average daily milk yield for the last portion of each period, also the percentage composition of the milk:

PERIOD.		Specific gravity.	Total solids.	Solids not fat.	Fat.	Milk yield per day.	
						Lbs.	Ozs.
1	Jem	1.0297	17.79	10.00	7.78	6	15
	Meg	1.0308	15.13	9.52	5.61	9	13
2	Jem	1.0319	16.37	10.09	6.29	10	8
	Meg	1.0328	14.48	9.77	4.69	12	3
3	Jem	1.0305	17.22	10.22	6.99	9	4
	Meg	1.0319	15.19	9.85	5.34	11	5
4	Jem	1.0326	17.64	10.67	6.97	8	9
	Meg	1.0321	15.49	10.41	5.08	10	15
2	Ceres	1.0308	13.73	9.36	4.37	29	0
	Juno	1.0289	14.07	9.03	5.04	30	14
3	Ceres	1.0304	14.65	9.45	5.20	27	0
	Juno	1.0281	14.52	8.92	5.60	24	13
4	Ceres	1.0306	13.90	9.22	4.68	27	5
	Juno	1.0263	14.34	8.51	5.83	18	2

The rapid falling off of Juno in milk yield is due, as previously stated, to her refusal to eat either linseed meal or wheat bran except in very small quantities.

As showing more plainly the influence of the food on the milk, we give the average yield per day of the solids and fats for the last portion of each period as calculated from the analyses:

PERIOD.	Solids per day, ounces.		Solids not fat per day, ounces.		Fat per day, ounces.	
	Jem.	Meg.	Jem.	Meg.	Jem.	Meg.
1	19.8	23.6	11.1	14.8	8.7	8.8
2	27.0	28.2	16.6	18.1	10.4	9.1
3	26.5	27.4	15.9	17.8	10.6	9.6
4	24.3	26.9	14.8	16.0	9.5	8.9
	Ceres.	Juno.	Ceres.	Juno.	Ceres.	Juno.
2	63.54	69.07	43.30	45.59	20.24	24.48
3	63.19	57.24	40.76	35.38	22.43	21.86
4	60.54	41.50	40.06	24.98	20,48	16.62

In the eight churnings made during the series of feeding with the two Jersey cows, Jem and Meg, there were required 15.82 pounds of milk for one pound of butter. With the eleven churnings in the series with the two native animals, there were required 18.31 pounds of milk for the production of one pound of butter. For the last churning of each period both the milk and butter have been analyzed, so we have the data for determining the average product per day.

Jem and Meg.

PERIOD.	Milk set, ounces.	Fat in milk set, ounces.	Fat in butter, ounces.	Fat lost, ounces.	Loss of fat, per cent.	Pds. milk for 1 lb. butter.
1	254.7	16.76	14.42	2.34	13.88	15.18
2	347.4	18.70	16.28	2.42	12.99	16.62
3	326.2	20.24	17.86	2.38	11.74	15.68
4 a	304.4	18.00	15.60	2.38	13.31	16.01
b	303.8	17.90	14.84	3.06	17.13	....
CERES AND JUNO.						
2	948.4	44.03	40.04	3.99	9.06	19.48
3	841.9	44.71	40.96	3.75	8.38	17.46
4	746.5	37.46	34.25	3.21	8.29	18.30

The composition of the butters examined for the several periods is shown by the following table:

Jem and Meg.

STATION NUMBER.	Period.	Water.	Fat.	Ash (salt).	Curd by dif.
2,109	1	11.35	86.04	2.07	.54
2,115	2	9.68	87.78	1.75	.79
2,178	2	11.93	85.28	2.10	.69
2,183	3	10.77	86.23	2.05	.95
2,194	4	11.55	85.74	1.82	.89
2,208	4	24.48	67.79	4.27	.46
CERES AND JUNO.					
2,234	2	11.55	85.19	2.50	.76
2,248	3	13.79	82.94	2.51	.76
2,258	3	13.20	83.38	2.69	.73
2,282	4	14.12	83.04	2.15	.69

The composition of the butter fats for the last churning of each period has been further examined by several well-known tests, and the results appear in the following table:

STATION NUMBER.	Period.	Reichert's test N_{10} Na O H.	Iodine No. Hubl's test.	Milligram K O H for 1 gram fat, Koettstorfer's test.	Melting point, Wiley's method.	Viscosity of soap solution, Babcock's method.
2,109	1	11.3	31.11	230.2	32.4	78
2,178	2	12.0	31.79	227.3	33.3	63
2,183	3	12.1	34.58	222.0	34.9	102
2,208	4	12.4	29.70	221.5	33.5	74
2,234	2	12.7	43.80	233.6	32.4	151
2,258	3	11.5	46.90	228.0	30.3	286
2,282	4	12.3	34.70	....	32.6	124

Having given the average results of the several trials and the analytical data obtained, we may now briefly discuss the points under consideration.

INFLUENCE OF FOOD ON THE MILK.

With Jem and Meg under hay feed, the lowest milk yield per day was had, but the addition of corn meal to the ration increased markedly the flow of milk. In the two periods following the corn meal, with linseed meal and with wheat bran, there was a gradual diminution in the milk flow. Similar results followed in the trial with Ceres and Juno, but the figures for Juno should not enter into the comparison, although given, since she refused to eat her ration of linseed meal or of wheat bran, except in small quantities, which probably did not average more than one pound per day for the period.

The analysis of the milk shows somewhat the influence of the food, but it is only in the absolute amounts of solids and fat per day that we can trace fully the influence. Although the milk yield fell off considerably in periods three and four over that of period two, yet the absolute amount of fat per day was greatest in period three under linseed meal feed. Particularly is this the case with Ceres. We can not, however, attribute the increased fat to the peculiar properties of any particular feed, since the ration in period three was richer in albuminoids than in either other periods.

With Jem and Meg the milk yield was brought from its lowest to the highest yield per day under the feed with corn meal, although the albuminoids consumed was much lower than in either of the following periods. With Ceres and Juno the largest flow of milk was under corn meal feed. In the following periods, although furnished a much larger amount of albuminoids, which was accompanied also by a greater consumption of hay, yet the flow of milk fell off quite rapidly. This would indicate a greater value to corn meal as a milk producer than either linseed meal or wheat bran.

Another point shown in these experiments is that the largest milk yield from the same cows does not necessarily give the greatest amount of butter, for in every case we secured the largest amount of butter with a smaller amount of milk produced by linseed meal feeding.

DOES FOOD INFLUENCE THE COMPOSITION OF BUTTER?

For the study of this particular question — the influence of food on the butter — the winter's feeding experiments were largely planned and carried out. It has been the general impression that the food did not influence the composition of the butter fats, but rather that the composition of the fats was individual and breed characteristics inherent in the animal. The most of the German experiments, as well as those conducted in this country, have tended to show this to be the case, although in a few instances results have been obtained which would indicate that such was not always the case.

My studies, upon the composition of our feeding stuffs, especially of the albuminoids and oils, have led me to think that, at least in some instances, the peculiar properties of the food did affect the composition of the butter and animal products produced from them. I selected three grain feeds, corn meal, linseed meal and wheat bran, to be used in connection with hay feed to learn what difference, if any, could be detected in the butter.

The conditions of feeding and experiment have already been given, and need not be repeated, and the results of the trials have been given in the tabular form in the preceding pages. The tests applied for the purpose of detecting any difference are the well-known tests given in the last table, but the Iodine and Viscosity tests were the ones to show most plainly the difference. The Iodine number indicates the amount of olein present and the viscosity test of the butter soaps marks the slightest changes in the composition and physical properties of the fats. The figures given are not the results of single trials, but the average for a number of tests.

As indicated by the Iodine number, between the butter produced under corn meal feed and that produced under linseed meal feed there is a difference of nearly 3.5 per cent in the olein. The cows under linseed meal feed produced a butter having the higher per cent of olein, and this was true in both series of trials with two animals in each case. The butter under wheat bran feed gave the lowest Iodine number, although immediately following linseed meal.

The viscosity of the soap solutions of the butter fats under the different feeds were as follows in the two series of trials:

	Jem and Meg.	Ceres and Juno.
Hay feed	78	...
Corn meal feed	63	151
Linseed meal feed	102	286
Wheat bran feed	74	124

Taking the Iodine number and the viscosity of the soaps for the butter fats as an indication of changes in composition, we are led to conclude that food may effect the composition of butter fats.

FEEDING EXPERIMENT.

BESS AND JESS.

At the beginning of this trial, December 15, the two heifers, Bess and Jess, were two years and six months old, having been purchased by the Station July 14, 1885, at five weeks old. From the time of their arrival at the Station to the beginning of the present feeding, 880 days, Bess increased in live weight 1,014 pounds, or 1.24 pounds per day on the average, while Jess for the same period made an increase in live weight of 811 pounds, or 0.92 pounds per day. At the beginning of this trial Bess weighed 1,106 pounds and Jess 903 pounds.

During the 120 days feeding experiment in 1886-7 we find that these two heifers, according to the summary from Dr. Sturtevant's report,* consumed the following amounts of food :

"*Bess.*—1,617 pounds hay ; 257 pounds corn meal ; 280 pounds linseed meal ; 141 pounds bran ; 390 pounds ensilage." Increased in weight for average weighings 166 pounds, or 1.38 pounds per day.

"*Jess.*—801 pounds hay ; 603 pounds corn meal ; 49 pounds linseed meal ; 135 pounds bran ; 390 pounds ensilage." Increased in weight for average weighings 176 pounds, or 1.46 pounds per day.

From the close of Dr. Sturtevant's feeding experiment, March 30, 1887, to the beginning of the present trial, 259 days, Bess increased in live weight 183 pounds, or 0.7 pounds per day ; Jess gained 142 pounds, or .55 pounds, the feed being ordinary feed of hay and grain or pasturage.

From December 15 to January 16 Jess received hay and corn meal, while Bess had a part of her hay feed replaced by oat straw and a quantity of cottonseed meal substituted for a part of the corn meal. January 15 to February 19 the feed for the two heifers was reversed, Bess receiving the hay ration and Jess a ration containing the straw. February 19 to the close of the experiment both Bess and Jess were fed the same variety of food. Until March 10 each received in addition four quarts per day of roots.

Dividing the whole period of 99 days feeding into three periods of 32, 34 and 33 days of like feeding, and we have as follows for the food consumed :

Period 1, 32 *days.*

Bess.—154 pounds hay ; 302 pounds oat straw ; 157 pounds corn meal ; 44 pounds cottonseed meal ; 128 quarts roots. Increase in live weight, 31 pounds.

Jess.—373 pounds hay ; 160 pounds corn meal ; 128 quarts roots. Increase in live weight, 36 pounds.

Period 2, 34 *days.*

Bess.—653 pounds hay ; 255 pounds corn meal ; 136 quarts roots. Increase in live weight, 72 pounds.

Jess.—136 pounds hay ; 241 pounds straw ; 80 pounds corn meal ; 48 pounds cottonseed meal ; 138 quarts roots. Increase in live weight, 41 pounds.

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* Sixth Annual Report New York Agricultural Experiment Station, 1886, pp. 23-26.

Period 3, 33 *days.*

Bess.— 540 pounds hay; 165 pounds corn meal; 66 pounds wheat bran; 99 pounds cottonseed meal. Increased weight, 62 pounds.

Jess.— 453 pounds hay; 132 pounds corn meal; 49 pounds wheat bran; 82 pounds cottonseed meal. Increased weight, 57 pounds.

The chemical composition of the several feeds used in this trial is given in the table of analyses, Nos. 2,032, 2,034, 2,040, 2,042, 2,112 and 2,203. The dry matter consumed per day and the average daily increase in weight is presented below, the first being for period one:

	Hay, lbs.	Oat straw, lbs.	Cotton-seed meal, lbs.	Corn meal, lbs.	Roots, lbs.	Water drunk, lbs.	Daily increase in weight, lbs.
Bess....................	4.06	7.68	1.31	3.96	.38	40.3	.97
Jess....................	9.91	......	......	4.05	.38	39.5	1.12

The dry matter consumed per day for period two, and the daily increase, is shown by the following table:

	Hay, lbs.	Oat straw, lbs.	Cotton-seed meal, lbs.	Corn meal, lbs.	Roots, lbs.	Water drunk, lbs.	Daily increase in weight, lbs.
Bess....................	15.24	......	......	6.07	.38	55.7	2.11
Jess....................	3.38	5.80	1.40	2.02	.38	26.1	1.21

For period three, the amount of dry matter eaten per day, and the increase in live weight, is shown by the following table:

	Hay, lbs.	Cotton-seed meal, lbs.	Corn meal, lbs.	Wheat bran, lbs.	Roots, lbs.	Water drunk, lbs.	Daily increase in weight, lbs.
Bess....................	13.87	2.81	4.05	1.71	.17	59.8	1.89
Jess....................	11.76	2.34	3.24	1.29	.17	44.1	1.73

The amount of the several food elements consumed per day, for the first period, is presented below:

	ASH, LBS.		ALBUMINOIDS, LBS.		CRUDE FIBER, LBS.		NITROGEN-FREE EXTRACT, LBS.		FAT, LBS.	
	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.
Hay	.25	.61	.36	.88	1.43	3.47	1.87	4.53	.14	.33
Oat straw	.53	......	.35	......	3.27	......	3.32	......	.20	......
Cottonseed meal	.10	......	.79	......	.02	......	.24	......	.16	......
Corn meal	.05	.06	.47	.48	.07	.07	3.19	3.25	.18	.19
Roots	.04	.04	.06	.06	.06	.06	.21	.21	.01	.01
Total	.97	.71	2.03	1.42	4.85	5.60	8.83	7.98	.69	.53

For the second period the daily amounts averaged as follows:

	ASH, LBS.		ALBUMINOIDS, LBS.		CRUDE FIBER, LBS.		NITROGEN-FREE EXTRACT, LBS.		FAT, LBS.	
	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.
Hay	1.01	.21	1.45	.30	5.74	1.20	7.49	1.56	.54	.11
Oat straw	......	.40	......	.27	......	2.47	......	2.51	......	.15
Cottonseed meal	......	.11	......	.84	......	.02	......	.26	......	.17
Corn meal	.08	.03	.71	.24	.11	.04	4.88	1.63	.28	.09
Roots	.04	.04	.06	.06	.06	.06	.21	.21	.01	.01
Total	1.13	.79	2.22	1.71	5.91	3.79	12.58	6.17	.83	.53

For the third period we have the following amounts consumed per day. For the last few days no roots were fed:

	ASH, LBS.		ALBUMINOIDS, LBS.		CRUDE FIBER, LBS.		NITROGEN-FREE EXTRACT, LBS.		FAT, LBS.	
	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.
Hay	.86	.73	1.24	1.05	4.90	4.16	6.40	5.42	.47	.39
Cottonseed meal	.22	.18	1.69	1.41	.04	.03	.52	.43	.34	.29
Wheat bran	.11	.08	.34	.26	.17	.13	.91	.68	.08	.06
Corn meal	.06	.05	.47	.38	.07	.06	3.26	2.60	.18	.15
Roots	.02	.02	.04	.04	.04	.04	.12	.12	.01	.01
Total	1.27	1.06	3.78	3.14	5.22	4.42	11.21	9.25	1.08	.90

Bringing together the average amounts per day for each period, and the average daily gain, we have the following table:*

PERIOD.	ASH, LBS.		ALBUMINOIDS, LBS.		CRUDE FIBER, LBS.		NITROGEN-FREE EXTRACT, LBS.		FAT, LBS.		DAILY GAIN, LBS.	
	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.	Bess.	Jess.
1	.97	.71	2.03	1.42	4.85	5.60	8.83	7.98	.69	.53	.97	1.12
2	1.13	.79	2.22	1.71	5.91	3.79	12.58	6.17	.83	.53	2.11	1.21
3	1.27	1.06	3.78	3.14	5.22	4.42	11.21	9.25	1.08	.90	1.89	1.73

The total dry matter per day consumed for each period by the two animals is shown by the following, expressed in pounds:

Period.	Bess.	Jess.
1	17.34	14.34
2	21.69	12.98
3	22.61	18.80

According to German standards, Bess called for 24 to 26 pounds dry matter per day, and Jess 20 to 24 pounds. As a matter of fact, they were at no time induced to eat this amount of dry matter. Bess, weighing about 1,100 pounds, made her best gain on 21.69 pounds dry matter per day, and Jess, weighing about 1,000 pounds, ate but 12.98 pounds per day in the second period, when straw formed a part of the ration.

Taking the figures for the digestion coëfficients from Armsby's Manual of Cattle Feeding for the feeds used in the several rations, we have for the nutritive ratio as follows for Bess:

Period.	Nutritive ratio.	Gain per day, lbs.
1	1: 5.69	.97
2	1:10.	2.11
3	1: 4.88	1.89

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* April 9, Bess and Jess were disposed of for beef, and when slaughtered the following figures were furnished us by the butcher:

	Bess.	Jess.
Live weight	1,280 lbs.	1,060 lbs.
Hide	80 lbs.	70 lbs.
Tallow	103 lbs.	73 lbs.
Meat and bone	768 lbs.	606 lbs.

Calculating in the same manner for Jess, we have the following:

Period.	Nutritive ratio.	Gain per day, lbs.
1	1:9.78	1.12
2	1:6.25	1.21
3	1:4.82	1.73

Based on these figures we find Bess made the largest gain per day on the widest nutritive ratio, that is with corn meal feed. Jess, on the other hand, made a better gain through each period as the nutritive ratio was narrowed.

CORN FODDER VS. ENSILAGE.

For this feeding experiment two Jersey heifers were selected, Belle two years old, and May, one year and nine months at the beginning of the experiment, December 18. At this date Belle weighed 889 pounds and May 713 pounds. Equal quantities of hay and linseed meal were fed to each, but the fodder corn and ensilage were fed *ad libitum*, and the unconsumed portion weighed back each day. From December 18 to February 1, 45 days, Belle made an average daily gain of 0.24 pounds and May 1.5 pounds, while the feed per day averaged as follows:

	Hay, lbs.	Corn fodder, lbs.	Ensilage, lbs.	Linseed meal, lbs.	Weight at beginning, lbs.	Weight at close, lbs.	Increase for 45 days, lbs.
Belle	8.66	3.2	....	3	789	800	11
May	8.66	....	21.0	3	713	783	70

From February 1 to March 17, 45 days, Belle made an average daily increase in weight of 1.26 pounds, while May lost 0.15 pounds. The feed per day was as below:

	Hay, lbs.	Corn fodder, lbs.	Ensilage, lbs.	Linseed meal, lbs.	Weight at beginning, lbs.	Weight at close, lbs.	Increase for 45 days, lbs.
Belle	8	....	22.5	3	800	857	57
May	8	4.3	....	3	783	776	—7

The heifers were then both offered the same amount and kind of food and consumed per day on the average as below for 15 days, with an average daily gain of 1.4 pounds for Belle and 1.7 pounds for May:

	Hay, lbs.	Linseed meal, lbs.	Corn meal, lbs.	Wheat bran, lbs.	Potatoes, lbs.	Weight at beginning, lbs.	Weight at close, lbs,	Increase for 15 days, lbs.
Belle	11.1	1	2	2	15	857	878	21
May	8.9	1	2	2	15	776	799	23

In order that we may better compare the results, we give the daily total dry matter consumed for each of the two periods. During the first period the amount of dry matter per day was as follows:

	Hay, lbs.	Corn fodder, lbs.	Ensilage, lbs.	Linseed meal, lbs.	Total dry matter per day, lbs.
Belle..............................	7.36	2.47	....	2.65	12.48
May..............................	7.36	....	4.09	2.65	14.40

During the second forty-five days the average amount of dry matter per day was as follows:

	Hay, lbs.	Corn fodder, lbs.	Ensilage, lbs.	Linsoed meal, lbs.	Total dry matter per day, lbs.
Belle..............................	6.80	....	4.39	2.65	13.84
May..............................	6.80	3.33	....	2.65	12.78

The chemical composition of these feeds is given in the table of analyses Nos. 2,032, 2,112, 2,113, 2,114, 2,203 and 2,235.

The amount of matter consumed per day was as below for the first forty-five days:

	ASH, LBS.		ALBUMINOID, LBS.		CRUDE FIBER, LBS.		NITROGEN-FREE EXTRACT, LBS.		FAT, LBS.	
	Belle,	May.	Belle.	May.	Belle.	May.	Belle.	May.	Belle.	May.
Hay..................	.43	.43	.55	.55	2.38	2.38	3.70	3.70	.22	.22
Corn fodder.........	.17	....	.21	....	.91	....	1.15	....	.04	.....
Ensilage	.....	.26	......	.34	......	.76	......	2.61	......	.11
Linseed meal........	.14	.14	1.06	1.06	.35	.35	.85	.85	.25	.25
	.74	.83	1.82	1.95	3.64	3.49	5.70	7.16	.51	.58

In the second period the amounts consumed were as follows:

	ASH, LBS.		ALBUMINOID, LBS.		CRUDE FIBER LBS.		NITROGEN-FREE EXTRACT, LBS.		FAT, LBS.	
	Belle.	May.	Belle.	May.	Belle.	May.	Belle.	May.	Belle.	May.
Hay	.38	.38	.51	.51	2.20	2.20	3.42	3.42	.20	.20
Corn fodder	......	.23	......	.28	......	1.22	......	1.54	......	.05
Ensilage	.28	......	.36	......	.81	......	2.80	......	.12	......
Linseed meal	.14	.14	1.06	1.06	.35	.35	.85	.85	.25	.25
	.80	.75	1.93	1.85	3.36	3.77	7.07	5.81	.57	.50

The average amounts fed per day during the last fifteen days were as follows:

	ASH, LBS.		ALBUMINOID, LBS.		CRUDE FIBER, LBS.		NITROGEN-FREE EXTRACT. LBS.		FAT, LBS.	
	Belle.	May.	Belle.	May.	Belle.	May.	Belle.	May.	Belle.	May.
Hay	.55	.44	.71	.57	3.06	2.45	4.84	3.88	.28	.22
Linseed meal	.04	.04	.35	.35	.12	.12	.28	.28	.08	.08
Corn meal	.02	.02	.19	.19	.03	.03	1.30	1.30	.07	.07
Wheat bran	.11	.11	.34	.34	17	.17	.91	.91	.08	.08
Potatoes	.11	.11	.36	.36	.10	.10	2.62	2.62	.01	.01
Total	.83	.72	1.95	1.81	3.48	2.87	9.95	8.99	.52	.46

In each period when ensilage was fed as a part of the ration, in comparison with corn fodder, we find that a larger amount was eaten of dry matter as ensilage, and there was a marked increase in weight, while with the corn fodder the gain was small in the first period with Belle, and in the second period there was a loss of weight by May. When the two heifers were each offered the same amount of like food, May ate the less quantity, but made the greater gain.

For the whole period of 105 days, Belle gained in weight 89 pounds and May 86; or .85 pounds per day for Belle and .82 pounds for May.

SHEEP-FEEDING EXPERIMENT.

FOR FAT AND FOR LEAN MEAT.

The question of feeding for fat and for lean meat, which has been made prominent in this country by the recent experiments of Professors Sanborn, of Missouri, and Henry, of Wisconsin, is of such practical importance that a few experiments in this line have been carried out at this Station during the past year.

For the purpose of our trial sheep were selected and the experiment was begun with four pens, two sheep to each pen. Two pens contained mature sheep for fattening, and lambs of good growth were placed in the other pens. The lots were made as uniform as possible, both as regards weight and general appearance.

The object in selecting both lambs and mature sheep was to find whether the mature animals would produce the same growth of lean meat, with a nitrogenous food, as young and growing animals, or whether this lean meat must be built up largely during the period of growth. After about six weeks feeding the sheep receiving a nitrogenous food sickened and died from the effect of too concentrated grain feed, thus destroying the part of our experiment with mature sheep, but the lambs continued to do well, although not fed heavily with grain. The trial with the mature sheep will be repeated during the winter of 1888–9 in connection with others of a similar nature, substituting linseed meal for cottonseed meal.

The feeding was carried out by Mr. Churchill according to my directions, his assistance making the trial possible.

PLAN OF THE FEEDING.

At the beginning of the experiment, January 4, the weight of the lambs in each pen was as follows:

	Pen 6, lbs.	Pen 7, lbs.
Lamb 1	72	75
Lamb 2	71	70

At the close of the trial, May 15, their weights were as below:

	Pen 6, lbs.	Pen 7, lbs.
Lamb 1	85	91
Lamb 2	78	75

The feed of these lambs was hay alike to both pens, and pen 6 received from January 4 to February 7 four ounces per day of a mixture in equal bulks of wheat bran and cottonseed meal. Pen 7 received four ounces per day of whole corn for the same period. From February 7 to May 15 the grain feed was increased to eight ounces per day and the hay feed increased from 3 pounds to 3.5 pounds per day for each pen. The actual amount of food consumed for the 132 days by each pen is shown by the accompanying table:

	Pen 6, lbs.	Pen 7, lbs.
Hay	425	407
Cottonseed meal and wheat bran	58	..
Whole corn	..	58

The hay fed was of mixed grasses, timothy, red top and red clover, and was in good condition.

It will be seen from the above that these lambs were at no time fed heavily and only intended to make growth. At the close of this trial lamb No. 1 from each pen was killed and the lean and fat meat separated and weighed, the results of which are given below. Lamb No. 2 of each pen is to be kept at pasture during the summer and put with others for a continuation of the feeding trial another winter.

TABLE SHOWING LIVE WEIGHT AND GAIN DURING FEEDING.

	Pen 6. Cottonseed meal, grams.	Pen 7. Whole corn, grams.
Live weight January 4	32659.2	34020.0
Live weight May 15	38646.7	41447.7
Gain in live weight	5987.5	7427.7
Daily gain	45.3	56.2
Per cent of gain on live weight	18.3	21.8

In the following table are given the weights of the several parts of each sheep:

	Pen 6, grams.	Pen 7, grams.
Live weight	38646.7	41447.7
Blood	1417.5	1445.8
Pelt and wool	5216.4	4677.7
Digestive canal and contents	11113.2	12360.6
Organs of respiration and circulation	1133.9	1275.7
Head and tongue	1483.0	1587.6
Carcass	16696.1	19501.2
Loss in working	1586.6	599.1

The greater loss in case of the sheep in pen 6 came mainly from a loss of water and partially masticated hay which ran from the mouth when the animal was hung up. Fully a quart was lost in this way and accounts for the large difference.

In the following table we present the weights of some of the separate organs and parts, included in the previous table.

	Pen 6, grams.	Pen 7, grams.
Stomach and contents	7021.5	7624.1
Intestines and contents	2636.5	3090.1
Head	1263.0	1366.6
Tongue	220.0	221.0
Spleen	57.0	53.0
Lungs	404.0	406.0
Liver	371.0	436.0
Heart	146.0	150.0
Kidneys	73.0	79.0
Kidney fat	476.0	649.0
Caul fat	713.0	1100.0
Diaphragm	208.0	158.0
Bones	3402.0	3628.8
Skin	2494.8	2735.6
Wool	2694.0	1970.3
Meat	11773.2	10319.4

The total length of the alimentary canal was practically the same for both, or about 104 feet.

The separation of parts and of fat and lean meat was wholly mechanical, and, while not strictly correct, yet the results are just as comparable for our purpose. There remained adhering to the lean meat bits of fat which could not be separated mechanically, and traces of lean were to be found in the fat meat. Especially is this last true in the case of the cottonseed meal fed lamb, for ramifying all through the body fat were fibers of lean, giving the whole a reddish appearance.

In the following table are presented the proportion of fat and lean meat, together with the percentage relations:

	Pen 6, grams.	Pen 7, grams.
Live weight	38646.6	41447.7
Carcass	16696.1	19501.2
Lean meat	9732.0	6463.8
Fat meat	2041.2	3855.6
Per cent of fat meat to lean	20.9	59.6
Per cent of fat meat to live weight	5.2	9.2
Per cent of fat meat to carcass	12.2	19.8
Per cent of lean meat to live weight	25.2	15.3
Per cent of lean meat to carcass	58.3	33.1

From the tables already presented we find that while lamb No. 1, in pen 7, fed on corn meal, made a better gain than lamb 1, in pen 6, fed on cottonseed meal (although the total gain for each pen was the same — 21 pounds), yet the proportion of lean to fat was decidedly changed by the two methods of feeding. Whether with mature animals we should be able to so largely influence the nature of the gain in favor of the lean meat under economical feeding is an undetermined question. I am of the opinion from my observations on previous experiments that feeders who would secure the greatest possible proportion of lean meat to the fat should begin with the growing animals, and not with those of mature growth.

ARTIFICIAL *vs.* ANIMAL DIGESTION.

By means of artificial digestion of feeding-stuffs we can determine the relative digestibility for the albuminoids of the several substances, and thus secure a measure of the digestibility of the fodder itself. That this artificial digestion corresponds with the actual results obtained with animals is not claimed, but that it comes quite close to those figures may be shown by actual trials in comparison of artificial and animal digestion. I have on four occasions, at the New York Agricultural Station, been able to test the value of artificial digestion along with animal digestion and the results were, in round numbers, as follows for the albuminoids of the fodder:

	Pepsin digestion.	Animal digestion
Corn fodder*	55	49
Soja fodder*	75	70
Orchard-grass hay	62	60
Corn meal	64	58

We see by the above that the coefficients of digestibility obtained by artificial digestion for the albuminoids were invariably higher than the actual results secured with the animals.

The digestibility of the albuminoids of corn meal, as found in the above trial, was much lower than has been given heretofore. In this case the digestibility of the meal was found with cows in a ration of corn meal and hay, the digestibility of the hay having been previously determined separately with the same animals and assumed to be the same in the ration as when fed alone. It should be borne in mind that the digestibility of corn meal as given, in most cases at least, has been made with hogs, animals very different in all respects from ruminants. With one exception, on a soft corn, I have never yet been able to obtain digestion coefficients for the albuminoids of corn meal as high as those given in the German tables or as found by Jordan† in his trials with hogs. The results given in the previous table for corn meal by pepsin digestion stands in about the same relation to animal digestion as in the trials with other feeds. Whether the digestion coefficient for the albuminoids of corn meal as now used are too high for ruminants, or whether in the trial I have reported* the digestibility of the albuminoids of the orchard-grass hay was largely modified when compounded in a ration, remains to be determined by future investigation. That the digestibility was modified to some extent I believe to be true, but not to the extent necessary to bring the figures of corn meal up to those usually given, and why this single anomaly in artificial digestion?

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* See American Chemical Journal, vol. VIII, No. 6.

† Report of Maine Agricultural Experiment Station.

Taking the result of American digestion experiments and the average of my own for pepsin digestion on similar foods, we have the following parallels:

	DIGESTION COEFFICIENT.	
	Pepsin digestion.	Animal digestion.
Timothy hay	52	44
Clover hay	57	53 to 56
Oat straw	18	....
Corn fodder	54	49 to 52

In the above, the averages given for both timothy and clover by pepsin digestion, are for twenty-four samples in full bloom. The variations in digestibility of the above were as follows:

Timothy	44 to 66
Clover	38 to 66

Stutzer, Jordan and others have shown that the results obtained in animal digestion are below the actual amount digested by the animal, due to biliary products, mucous matter, etc. The amount of this error depends upon the richness in albuminoids of the food under examination. Stutzer thought that a portion of the albuminoids of feed-stuffs was indigestible and this he called *nuclein*. This can hardly be true of all such substances and careful redigestion leads us to think that in most fodders all of the albuminoids may be finally digested. The following shows a few of our results from redigestion with pepsin:

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* Report of the Society for the Promotion of Agricultural Science, 1888.

	PER CENT ALBUMINOIDS DIGESTED.		
	First digestion.	Second digestion.	Third digestion.
Wheat	79	34	29
Timothy hay	59	29	34
Wheat bran	77	23	11

I can not say to what extent the digestibility might have been carried had the undigested residue been dried, reground and repeatedly digested, but each time to the third digestion showed a portion of the remaining albuminoids in each case to be digested.

Stutzer, Jordan, Kellner, Pfeiffer and others have concluded from their investigations that by subjecting the fæces to artificial digestion and taking the remaining portion as the undigested residue we have the digested portion of the food. There is no proof, so far as I am aware, to show that pepsin digestion of the fæces does not digest a portion of the food which was undigested by the animal. That it does do this seems probable from the fact that redigesting the fæces a second time gave another portion digested, as is shown below:

	PER CENT DIGESTED.	
	No. 1.	No. 2.
First digestion	18.13	13.10
Second digestion	8.36	7.18

If we assume that the amount actually digested by the cow is the apparent amount digested plus that portion of the fæces digested by a pepsin solution, then instead of the digestion coefficient for the albuminoids of orchard-grass hay being 60 per cent, it is nearly 68 per cent, or, if we take the amount redigested, it will be considerably increased over the last figures.

In the light of our present data we conclude:

1. That pepsin digestion furnishes us a reliable means of determining the digestibility of the albuminoids of our feeding stuffs, thus serving as a criterion of the digestibility of the fodder itself.

2. That the coefficients of digestibility for all foods, as usually calculated from animal digestion, are too low.

3. That the coefficient of digestibility for the albuminoids of corn meal *seems* to be too high for ruminants.

4. That in many of our feeding stuffs all of the albuminoids *seem* to be in a digestible form.

5. That the digestion of the fæces by a pepsin solution may, and probably does, in many cases digest a portion of the food which was undigested by the animal; that is, if we add to the results secured with the animal, the amount digested from the fæces by a pepsin solution, the coefficient of digestibility will be too high.

FERTILIZERS.

During the past year a much larger number of fertilizers have been received for analysis at the Station than in any previous year. At least one sample has been analyzed of such brands as have been sent in accordance with the instructions furnished by the Station for sampling and shipping, and the results reported to the interested parties. The Station valuation for these fertilizers, as based on the chemical analysis, has not been computed in the following table, but below is given the schedule of prices for the several fertilizing ingredients as adopted by the experiment stations of Connecticut and other eastern States:

SCHEDULE OF TRADE VALUES ADOPTED BY THE STATION FOR 1888.

	Cents per pound.
Nitrogen in ammonia salts	17½
Nitrogen in nitrates	16
Organic nitrogen in dried and fine ground fish, meat, blood, castor pomace and cottonseed meal	16½
Organic nitrogen in fine-ground bone and tankage	16½
Organic nitrogen in fine medium bone and tankage	13
Organic nitrogen in medium bone and tankage	10½
Organic nitrogen in coarser bone and tankage	8½
Organic nitrogen in horn shavings, hair and coarse fish scrap	8
Phosphoric acid, soluble in water	8
Phosphoric acid, soluble in ammonium citrate	8
Phosphoric acid in dry ground fish, fine bone and tankage	7
Phosphoric acid in fine medium bone and tankage	6
Phosphoric acid in medium bone and tankage	5

	Cents per pound.
Phosphoric acid in coarser bone and tankage	4
Phosphoric acid in fine-ground rock phosphate	2
Potash as high-grade sulphate, and in forms free from muriates (or chlorides)	5½
Potash as kainite	4¼
Potash as muriate	4¼

The names of the manufacturers, also the name and address of parties sending the fertilizers for analysis, are given in the first table. In the second table are given the analyses for the several fertilizers.

For the correctness of the sampling in those fertilizers sent to the Station for analysis we can not vouch, but wherever there has been any apparent failure to follow the instructions furnished by the Station the fertilizers were not analyzed.

Laboratory No.	MANUFACTURER.	Address.	Sent for analysis by	Address.
2259	Farmers' Fertilizer Co	Syracuse, N. Y.	James D. Mather	Marcellus, N. Y.
2293	Farmers' Fertilizer Co	Syracuse. N. Y.	George G.French	Mexico, N. Y.
2294	P. White & Son	Barren Island,N.Y.	T. W. Powell	Flushing, N. Y.
2296	Amos & Tobin	Baldwinsville, N.Y.	Jacob Amos	Baldw'sville, N.Y.
2303	Hallock & Duryre	Mattituck, N. Y.	G. E. Aldrich	Riverhead, N. Y.
2304	E. Frank Coe	Burling Slip, N. Y.	G. E. Aldrich	Riverhead, N. Y.
2305	George H. Randall	Brooklyn, N. Y.	G. E. Aldrich	Riverhead, N. Y.
2306	Lester Bros	Newark, N. J.	G. E. Aldrich	Riverhead, N. Y.
2307	Bowker Fertilizer Co	New York, N. Y.	G. E. Aldrich	Riverhead, N. Y.
2308	George W. Miles	Milford, Conn	S. B. Fanning	Jamesport, N. Y.
2309	Read & Co	Hart Lot, N. Y.	Station	
2310	New Process Fertilizer Co.	Hart Lot, N. Y.	Station	
2311	New Process Fertilizer Co.	Hart Lot, N. Y.	Station	
2320	Read & Co	Hart Lot, N. Y.	Station	
2328	New Process Fertilizer Co.	Hart Lot, N. Y.	Station	
2330	Bowker Fertilizer Co	New York, N. Y.	Station	
2321	Pacific Guano Co	New York, N. Y.	Station	
2449	Stearns Fertilizer Co	New York, N. Y.	A. H. Tuthill	Jamesport, N, Y.
2450	Orient Guano N. F. C. Co.	New York, N. Y.	A. H. Tuthill	Jamesport, N. Y.
2451	Bradley & Co	Boston, Mass	A. H. Tuthill	Jamesport, N. Y.
2452	Stearns Fertilizer Co	New York, N. Y.	A. H. Tuthill	Jamesport, N. Y.
2456	Farmers' Fertilizer Co	Syracuse, N. Y.	Warren Baker	Marcellus, N. Y.

Laboratory No.	BRAND.	Total Nitrogen.	Phosphoric Acid P_2O_5.					Potash K_2O.	Cost per ton.
			Soluble (in water).	Reverted.	Insoluble.	Total.	Available.		
2259	Standard Ammoniated Bone Phosphate	0.59	7.95	2.11	1.58	11.64	10.06	2.06	$28 00
2293	Standard Ammoniated Bone Phosphate	1.07	8.59	.45	.75	9.79	9.04	2.01	28 00
2294	Carpenter's Special Potato Fertilizer	4.27	6.42	2.59	1.91	10.92	9.01	6.73	40 00
2296	Tobin's Cottonseed Meal, Tobacco Formula	3.87	....	....	....	3.71	....	9.51	....
2303	Fertilizer No. 1	3.68	6.66	2.03	.70	9.39	8.69	12.90	35 00
2304	Red Brand	3.37	7.39	.06	1.99	9.44	7.45	6.08	40 00
2305	Riverhead Town Agricultural Society Fertilizer	3.27	4.22	2.88	2.46	9.56	7.10	9.85	35 00
2306	Lester Brothers' Potato Manure	4.12	8.44	.58	.22	9.24	9.02	6.99	38 00
2307	Stockbridge Potato and Vegetable Fertilizer	3.99	5.36	2.69	4.28	12.33	8.05	8.34	39 00
2308	Ceres Fertilizer, special	3.17	7.40	....	.76	8.16	7.40	7.63	33 50
2309	Empire State	1.66	5.90	2.29	2.99	11.18	8.19	3.89	....
2310	"New Process" Fertilizer, for winter and spring grains	2.27	2.38	....	1.26	3.64	2.38	4.77	....
2311	"New Process" Fertilizer, for grapes and small fruits	1.41	1.79	.79	.41	2.99	2.58	6.23	....
2320	High Grade Farmer's Friend	3.15	3.27	1.61	2.20	7.08	4.88	9.40	....
2328	"New Process," special for potatoes	1.64	2.10	1.22	.38	3.70	3.32	7.62	....
2330	Alkaline Bone	....	7.25	3.07	6.03	16.35	10.32	1.72	....

Laboraory No.	BRAND.	Total Nitrogen.	Phosphoric Acid P_2O_5.					Potash K_2O.	Cost per ton.
			Soluble (in water).	Reverted.	Insoluble.	Total.	Available.		
2432	Soluble Pacific Guano	3.06	6.95	1.16	2.76	10.87	8.11	4.20	....
2449	Stearns' Americo Guano	4.29	1.91	5.60	4.07	11.58	7.51	8.85	38 90
2450	Special Club Ammoniated Bone, with Potash	3.39	7.46	.26	tr	7.72	7.72	9.86	33 00
2451	Bradley's Complete Manure, for potatoes and vegetables*	3.88	7.02	....	....	9.34	....	9.34	38 00
2452	Stearns' Practical, with Science brand	4.95	....	3.25	4.47	7.72	3.25	18.52	45 00
2456	Standard Ammoniated Bone	1.04	7.99	3.27	.30	11.56	11.26	3.60	28.00

*In this sample the reverted and insoluble phosphoric acid was not determined.

PHOSPHATES.

No. 2322. Sampled from a lot of Thomas Scoria received for trial at the Station.

No. 2314. Sampled from a lot of bone black, purchased of Mapes Formula and Peruvian Guano Co., New York.

No. 2323. Ground South Carolina Rock, from Mapes Formula and Peruvian Guano Co., New York.

No. 2312. Dissolved South Carolina Rock, from Mapes Formula and Peruvian Guano Co., New York.

	Number.			
	2322	2314	2323	2312
Phosphoric acid :				
Soluble P_2O_5	0.	14.94		11.67
Reverted P_2O_5	4.93	1.15		2.73
Insoluble P_2O_5	7.22	0.		2.38
Total P_2O_5	12.15	16.09	26.39	16.78

A sample of fertilizer was analyzed for Daniel Batchelor, of Utica, the history of which is not known, but the results were as follows :

		Per cent.
Nitrogen		3.05
Phosphoric acid :		
Soluble P_2O_5	7.41	
Reverted P_2O_5	5.90	
Insoluble P_2O_5	.80	
Total P_2O_5		14.11
Potash K_2O		1.65

WOOD ASHES.

No. 2288. Sample received from G. H. Taylor, Chatham, N. Y. Said to be Canada hard wood ashes.

No. 2292. Received from F. H. Giddings, Baldwinsville, N. Y.

No. 2434. A sample of ashes received from L. M. Smith, Elmira, N. Y.

No. 2473. Ashes from acid works at Binghamton, N. Y. Sent by J. E. Rogers.

	Number.			
	2288	2292	2434	2473
Phosphoric acid P_2O_5	.74	1.48	1.48	1.40
Potash K_2O	5.16	8.81	6.95	5.55

Sample No. 2288 is rather low in potash and much below the average for phosphoric acid. Nos. 2292 and 2434 are very good unleached Canada ashes.

I believe it plainly the duty of our State to enact a fertilizer control law to protect the farmers against imposition on the part of those few unscrupulous dealers who now and then put upon the markets fertilizers which fall below the guarantee. The cost of the enforcement of such a law would be many times saved to the farmers. It would drive from the market spurious goods and raise the standard of those offered for sale. Such a law would revert to the benefit of the honest manufacturers and would receive their cordial support.

During the past year, in the case of two manufacturers at least, their fertilizers have been found considerably below what they should be, but one of them offers an explanation for their goods being below the guarantee, although the farmers were the parties to suffer by the lack of proper care. How extensive the sale of inferior goods is throughout the State I can not say, as only a few fertilizers are analyzed, and there is no record made of the sales in the State. One sample of so-called "corn fertilizer," sent by parties outside of the State, contained neither nitrogen, phosphoric acid nor potash in any appreciable quantities. Whether this product is being offered for sale I am not informed, but its worthlessness as a fertilizer is at once apparent.

We have been repeatedly asked by farmers and farmers' clubs to analyze fertilizers for them that they might feel sure they were not being defrauded, they offering to bear the necessary expense of analysis, or, if we could not do the work, to name some reliable chemist who would. This should not be, for the State can do this work at a nominal cost. So far as possible we have complied with the request without charge to the parties, but we have neither the means, laboratory facilities nor force for meeting this urgent and fast-growing demand on the part of the farmers, and have been obliged to refuse many of their requests, as precedence, with our limited quarters, must be given to regular Station work.

AMOUNT AND ANALYSIS OF DRAINAGE FROM EACH LYSIMETER FOR 1888.

LYSIMETER No. 1 — SOD.

	Rainfall, inches.	Drainage, inches.	PARTS PER MILLION.				
			Solids.	Chlorine.	Nitrogen as ammonia.	Nitrogen as nitrates.	Total nitrogen.
January	0.776	0	0	0	0	0	0
February	1.041	0	0	0	0	0	0
March	1.431	0	0	0	0	0	0
April	3.090	1.77	146	7.5	182	23.10	23.282
May	2.790	0	0	0	0	0	0
June	3.88	0	0	0	0	0	0
July	0.99	0	0	0	0	0	0
August	4.02	0	0	0	0	0	0
September	2.73	1.53	1,740	10	tr.	0	0
October	3.46	0	0	0	0	0	0

LYSIMETER No. 2 — BARE SOIL.

	Rainfall, inches.	Drainage, inches.	Solids.	Chlorine.	Nitrogen as ammonia.	Nitrogen as nitrates.	Total nitrogen.
January	0.776	0.155	451	5	.0689	39.488	35.557
February	1.041	0	0	0	0	0	0
March	1.431	0	0	0	0	0	0
April	3.090	1.15	690	5	.1488	91.090	91.239
May	2.790	0	0	0	0	0	0
June	3.88	.90	800	6	0	88.234	88.234
July	0.99	0	0	0	0	0	0
August	4.02	.93	868	5	.0451	86.36	86.4051
September	2.73	.555	668	10	0	78.461	78.461
October	3.46	1.06	744	5	0	69.29	60.290

LYSIMETER No. 3 — CULTIVATED SOIL.

	Rainfall, inches.	Drainage, inches.	Solids.	Chlorine.	Nitrogen as ammonia.	Nitrogen as nitrates.	Total nitrogen.
January	0.776	0.153	275	4	tr.	tr.	tr.
February	1.041	0	0	0	0	0	0
March	1.431	0	0	0	0	0	0
April	3.090	0.610	426	5	.1583	61.350	61.5083
May	2.790	0	0	0	0	0	0
June	3.88	1.15	624	5	tr.	83.016	83.016

AMOUNT AND ANALYSIS OF DRAINAGE — (*Continued*).

LYSIMETER No. 3 — CULTIVATED SOIL.

	Rainfall, inches.	Drawings, inches.	PARTS PER MILLION.				
			Solids.	Chlorine.	Nitrogen as ammonia.	Nitrogen as nitrates.	Total nitrogen.
July	0.99	0	0	0	0	0	0
August	4.02	.98	682	4	.0876	49.16	49.2476
September	2.73	.81	586	5	.1018	51.464	51.5658
October	3.46	1.67	552	4	tr.	34.02	34.0200

Monthly rainfall and drainage in tons per acre from each lysimeter, with the loss of nitrogen in pounds per acre for 1888.

	Rainfall, tons per acre.	DRAINAGE, TONS PER ACRE.			LOSS OF NITROGEN, POUNDS PER ACRE.		
		No. 1, sod.	No. 2, bare soil.	No. 3, cultivated soil.	No. 1.	No. 2.	No. 3.
January	87.85	0	17.55	17.32	0	1.25	tr.
February	117.86	0	0	0	0	0	0
March	162.01	0	0	0	0	0	0
April	349.84	200.39	130.20	69.07	9.33	23.76	8.50
May	315.88	0	0	0	0	0	0
June	439.28	0	101.89	130.20	0	16.96	12.82
July	112.08	0	0	0	0	0	0
August	455.14	0	105.29	110.95	0	18.19	20.93
September	309.08	173.22	62.83	91.70	0	9.86	9.45
October	391.73	0	120.02	189.17	0	15.12	12.86

On the first of each month samples of water were collected from Castle brook, which crosses the Station farm, and also from the outlet of the main drain from the experimental plats. The solids, chlorine, free ammonia and nitrates were determined in these waters, furnishing us some indication of the fertilizing matters which are being removed from the soil.

ANALYSIS OF DRAIN AND BROOK WATER.

SAMPLE TAKEN THE FIRST OF EACH MONTH.	PARTS PER MILLION.							
	DRAIN WATER.				BROOK WATER.			
	Solids.	Chlorine.	Nitrogen as ammonia.	Nitrogen as nitrates.	Solids.	Chlorine.	Nitrogen as ammonia.	Nitrogen as nitrates.
February	372	6	.0823	0	352	6	.0860	0
March	316	12	.362	0	288	3	tr	0
April	360	13	tr	tr	222	4	.1192	tr
May	378	6	tr	40.790	270	5	.0844	tr
June	378	7.5	tr	tr	290	5	,1321	0
July	402	12	.1383	44.315	336	10	tr	tr
August	0	0	0	0	330	15	tr	0
September	0	0	0	0	280	10	.0784	0
October	428	20	.853	0	302	10	.108	0
November	392	12	.0517	tr	310	6	.0632	0

REPORT OF FARM SUPERINTENDENT.*

The time of the farm superintendent has been largely occupied in permanent improvements of the water supply, also on drains and water pipes on the Station grounds, feeding experiments, and in superintending the labor on the Station farm. Much time has also been devoted to the new barn.

Some improvements on the farm have been the breaking up and cultivation of the area south of the plats lying between Castle street and Castle brook. A crop of corn has been taken off which will make a fair return for the labor expended and leave the land in much better condition than before.

A new waterway has been constructed across the farm by coöperation with the Van Dusen Nursery Company. This gives them a natural outlet for their lowland waters, and it is hoped will, with a little embankment on the west side of the old Preëmption road, prevent the unsightly gullying of one of the Station's fields by flood water. This main also gives an outlet for the drainage of the southwest corner of the farm. There are about 800 feet of this main ditch laid on the west side of the farm. Its eastern terminus is in the open ditch and run, extending to Castle brook, south of the tenement-houses. Eventually it should all be laid with tile and closed up. At present, however, it is impracticable, owing to a row of elm trees, the roots of which in their search for water would soon choke up the tiles and render them useless. A small willow patch has been cleared up and returned to cultivation.

SOIL AND ROTATION OF CROPS.

The heavy clay soil which constitutes the main part of the farm is capable of producing fair average crops under favorable conditions. It is proposed to increase the fertility by a rotation of crops, with at least one application of manure from the stables

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* F. E. Emery.

(with corn crop) in each course. This may be supplemented by a top-dressing or application of commercial fertilizers to one or more of the other crops as may be deemed expedient.

The course of rotation started is:

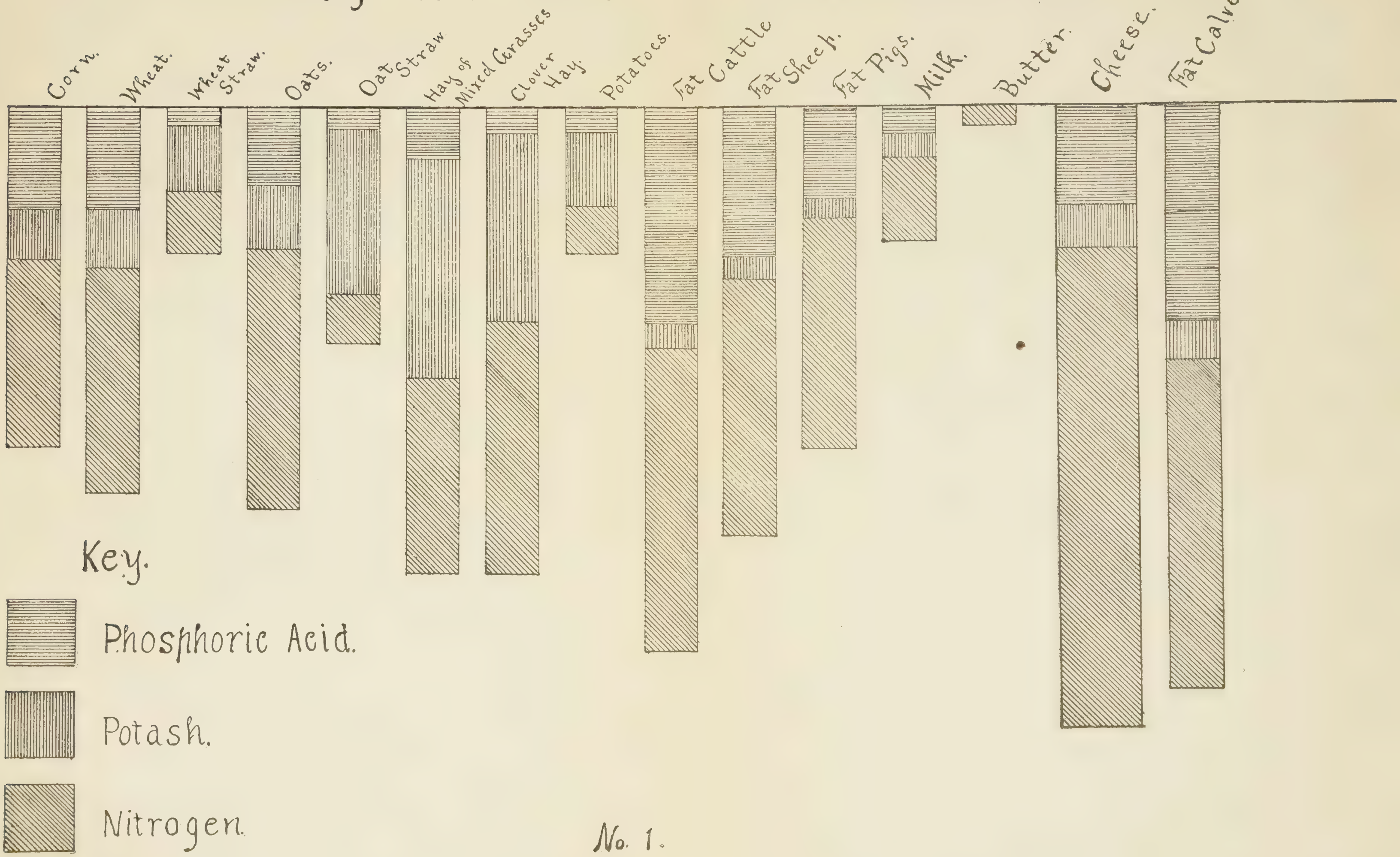
1. Corn on turf.
2. Forage, consisting of corn and sorghum and other green crops for soiling and ensilage, and roots.
3. Grain crop with seeding for grass.
4. Hay for two years.

The accompanying tabular statement of crops produced and those proposed for next season will convey a clearer idea of the rotation than a written description.

ROTATION OF CROPS PRODUCED AND PROPOSED ON THE STATION FARM.

	FIELD C, 10.53 acres.	FIELD D.	FIELD E.	FIELD F, 10.8 acres.	FIELD G, 10.37 acres.	FIELD H, 10.45 acres.	FIELDS I and J, 14.95 and 2.4 acres.
		24.73 acres.					
1882..	Pasture..........	....	....	....	....	....	Permanent pasture.
1883..	Pasture..........	Part in wheat and part in timothy.	Part in wheat and part in timothy.	Wheat	Barley	....	do.
1884..	Oats..........	Wheat..........	Corn.	Clover hay..........	Fallow	Pasture..........	do.
1885..	Corn	Clover..........	Oats..........	Corn	Wheat..........	Pasture..........	do.
1886..	High part seeded on corn rows for pasture.	Clover and tim'thy	Wheat	Oats..........	Wheat seeded for clover and timothy.	Corn	do.
1887..	Pasture; the low part of this field is within the banks of Castle brook, and has been in permanent pasture.	Corn and millet...	Clover and tim'thy	Wheat seeded for clover and timothy.	Hay	Oats..........	do.
1888..	Perman'nt pasture	Oats (seeded), alfalfa and grass plats.	Corn..........	Clover hay..........	Clover and timothy hay.	Ensilage and soiling crops	Corn.
1889..	Perman'nt pasture	Clover or wheat, alfalfa and grass plats.	Forage..........	Timothy	Corn..........	Grain	Oats.

Fertilizing Elements Sold in 2000 Pounds of:-



No. 1.

This plan provides for no money crop to be sold from the farm, but is adapted to make a more finished product from the stable the source of income. This seems to be the true course for a large class of our farmers. A point which may be graphically illustrated by a diagram * showing at a glance a comparison of the fertilizing elements (nitrogen, phosphoric acid and potash) removed from the farm in one ton of each kind of produce named. The average price of each is given in the table, with the value of the fertilizing elements, as well as what is left after subtracting fertilizing value removed. The remainder represents cost of seed, interest, taxes, labor, and last of all, profits.

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* Authorities consulted in making up the table from which the diagram was constructed were:

Warrington's Chemistry of the Farm.

Ladd: N. Y. Agricultural Experiment Station Reports and Bulletin 14, new series.

Koenig's Food Tables.

Watt's Chemical Dictionary.

Wolf's Tables.

Johnson's How Crops Grow, Eng. ed.

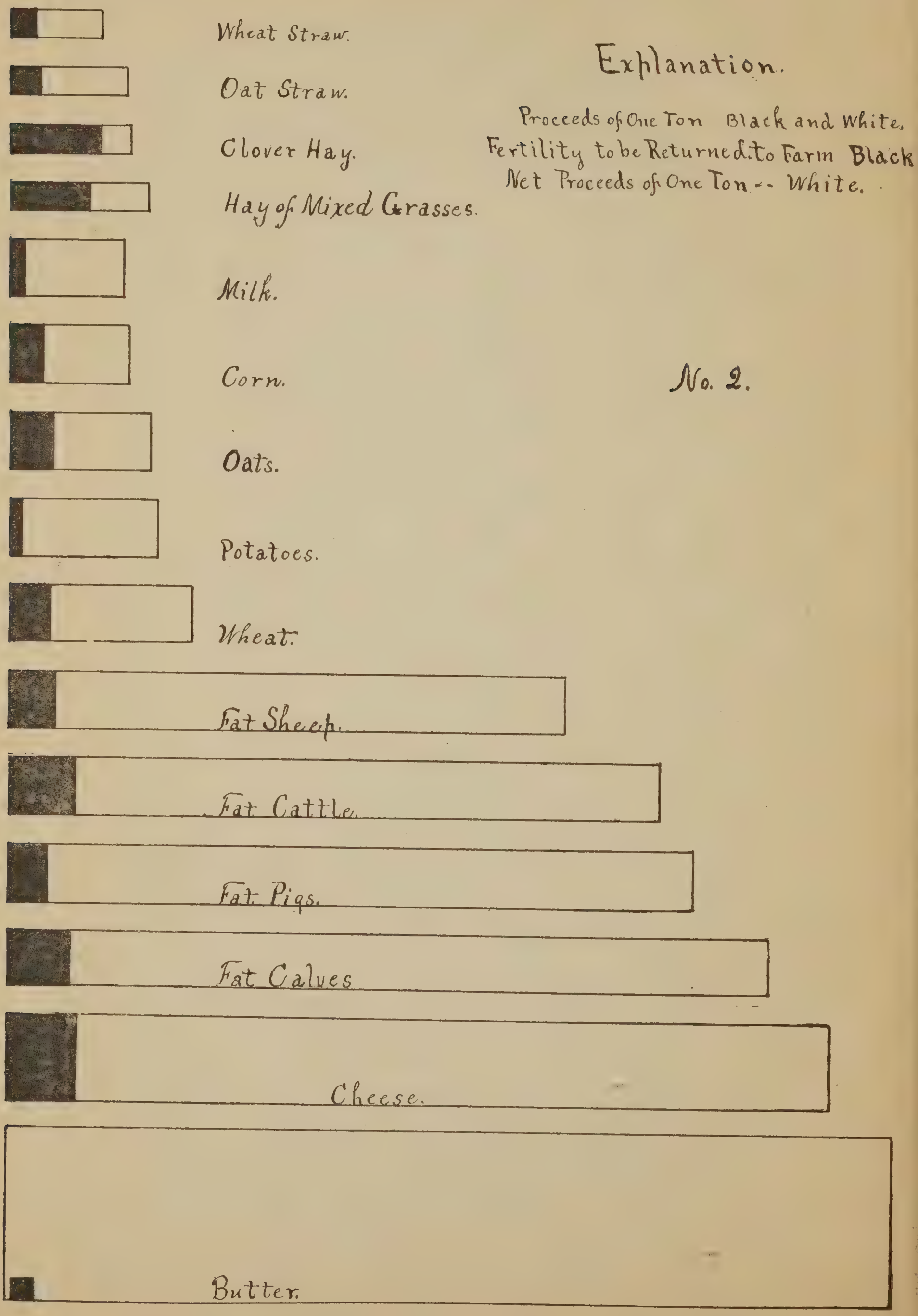
The prices at which the fertilizing elements have been calculated are:

17 cents per pound for nitrogen.
6 " " " phosphoric acid.
4.5 " " " potash.

FERTILIZING ELEMENTS SOLD IN TWO THOUSAND POUNDS OF—

FERTILIZING ELEMENTS.	Corn.	Wheat.	Wheat straw.	Oats.	Oat straw.	Mixed hay.	Clover hay.	Potatoes.	Fat oxen.	Fat sheep.	Fat pigs.	Milk.	Butter.	Cheese.	Fat calves.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs,	Lbs.	Lbs,	Lbs.	Lbs.	Lbs.
Phosphoric acid (P_2O_5)........	15.1	15.1	2.00	11.9	1.2	7.6	5.2	3.6	33.00	22.5	13.8	4.0	......	22.50	32.80
Potash (K_2O).........	7.9	8.8	10.5	9.8	27.0	33.5	22.4	11.2	3.68	3.18	2.96	3.4	......	5.07	5.80
Nitrogen (N).....................	28.5	34.2	9.5	39.0	7.6	29.6	38.6	7.7	46.4	39.2	35.1	12.80	2.8	113.24	48.96
Average market value in 1888, as taken once per month from C. G..........................	20.96	31.93	8.00	24.88	10.25	12.25	10.62½	25.80	114.30	97.54	119.90	20.00	464.16	216.60	133.71
Fertilizing value of one ton of each..........................	6.11	7.09	2.21	7.69	2.58	6.99	7.88	2.02	11.80	8.14	6.92	2.57	.48	20.83	10.55
Balance net income.........	14.85	24.84	5.79	17.19	7.67	5.26	2.75	23.78	102.50	89.40	113.00	17.43	463.68	195.77	123.16

Comparative Value of Farm Products.



It will be seen by the table and Diagram 1 that the amount of fertilizing matter in one ton of milk is a little less than in either one ton of wheat straw or potatoes, while by Diagram 2 and the table the market value of the fertilizing matter in milk is greater than that of either potatoes or wheat straw. This is due to the greater amount of nitrogen, the most costly of fertilizers, and of which potatoes contain less than either wheat straw or milk. Carrying this comparison further, and assuming 20 bushels of wheat or 100 bushels of potatoes to be the product of one acre, and that the yield of grain to straw is as 100 to 112.5, the net income (minus value of seed) from one acre of wheat becomes $18.38, while that of one acre of potatoes is $71.34. Deduct for 2 bushels seed wheat $3, and for 24 bushels of potatoes $18, and the comparative net income becomes $15.38 and $53.34, respectively.

Similar comparisons can and should be made with other articles.

If these prices vary much from those of any particular locality, it will only be necessary to add to or subtract from the net income an amount equal to the variation, in order to adapt the method and settle on a comparatively profitable crop.

The average market price, with two exceptions, wheat straw and milk, is the mean of market reports taken from the first issue of the *Cultivator and Country Gentleman* for each month of 1888. Wheat straw was only quoted a few times, and then at the price given, and the price of milk was fixed at 1 cent per pound or 2⅙ cents per quart.

In the refined animal product, while the percentage of fertilizing elements lost in a given weight sold is greater than in an equal weight of the field crops, yet this animal produce contains but a small percentage of the fertilizing value of the coarser crops from which it was derived. The greater part is left behind, while the ratio of net income has increased so much that the field crop can be paid for and used as animal food, leaving a handsome margin for profit, where the bulkier crop could not repay cost of handling in shipment to consumers. Such articles should be consumed as near the spot where produced as possible, because of the small margin above the fertilizing value received for them, and every farmer should study to change all the products of his farm and labor from the coarse, bulky forms, from which little can be realized on the market, to a fertilizing material and a more finished product, which yields a better return.

CROPS OF 1888.

The crops produced on the Station farm the past season have been weighed in almost all cases since the large scales were set up. Where estimations are given the yield is calculated from average weights taken on considerable areas of crop. For instance, on field E the weights on the 2½ acres of experiment plats serve as the average on which to compute the yield for 12.4 acres. Two acres on the plats were estimated at the average yield of 1¼ acre, which was weighed.

Oats and roots were all weighed, but oat straw was computed from the average of pounds of straw in per cent of total crop from the experiment with oats. Part of the hay was drawn in before the scales were set; hence about one-fourth was estimated from other weights. Corn grown for silage on 4.4 acres is computed on 1⅝ acre cut into silo.

All the figures on which estimations have been made are marked (Est.) in the following table:

CROPS PRODUCED IN 1888.

KIND.	Acres occupied.	Amount produced.		Yields per acre.
Hay	33.67	70 tons		2 + tons.
Barley	.516	15½ bushels		30 bushels.
Barley hay	.50	(Est.) included above		40 bushels.
Barley oats and peas	2.95	118 bushels		
Straw of barley, oats and peas	2.95	(Est.) 3 tons		1 + ton.
Oats	14,00	729 bushels		52 bushels.
Oat straw	14.00	(Est.) 15 tons		1 + ton.
Merchantable corn	14.4	(Est.) 750* bush..	field	58.1 bushels.
			plats	51.5 bushels.
Soft corn	14.4	(Est.) 4,824 lbs.	field	292.6 lbs.
			plats	598. lbs.
Stover	14.4	(Est.) 64,683 lbs.		4584. lbs.
Maize fodder, green, Sept. 11	4.4	(Est.) 55.72 tons		12.66 tons.
Sorgum fodder, green	.33	6,518 lbs		10 tons, nearly.
Maize fodder	.416	12,006 lbs		14.4 tons.
Carrots	.59	196 bushels		....
Turnips		206 bushels		....
Sugar beets	.80	430 bushels		537.5 bushels.

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* Counting the full crop as equal to the portions weighed would make the total 823 bushels, but in consideration of poor knolls and the ridge along the bank of Castle brook, it seems safe to drop the estimate to the figure given. The stover is reduced proportionally.

This table includes hay from the orchard and 2½ acres of corn and fodder on the plats; other plat crops, apples and garden crops are not included.

The corn on plats and main cornfield was cut and shocked between September 20 and 24. A small, irregular field planted June 6 was left until October and was cut up just in season to escape the heavy frost of the 10th. This corn had been slightly frosted, but is believed to have gained more than enough in maturity to offset the slight damage to stover from the frost.

The only dry month was July, and the drought came on in season to catch the potato crop, which suffered also from the depredations of the Colorado beetle and the cucumber flea beetle.

The late summer and early fall was so cloudy and wet that late crops were slow in coming to maturity, while great difficulty was experienced in securing them owing to the dull weather. Of all crops the hay crop was most favored; the cool, wet weather in spring fostered the growth of grass, while the dry weather later served well for its harvest in good condition.

FORAGE CROPS.

Zea mays, Indian Corn, Maize.

This is our standard forage crop. It is better known and more widely cultivated than any other. The variety grown especially for forage this year on the farm and plats is known as the B. & W., from Burrell & Whitman, of Little Falls, N. Y., who have introduced it from the south, where the seed is produced.

The method of planting was as follows: A good seed bed was prepared. All the tubes of the eight-tubed Empire State Seed Drill except two were closed. These two were the second from each end, or the second and seventh from one end. The drill was then set to sow two bushels per acre, but actually delivered considerable less, about twelve quarts from the two tubes, but this was rather too much seed, as the stalks were too thick for all to set ears. Most of that on the plats produced ears and reached the milk stage of growth. That in the field did not develop so evenly, and comparatively few ears were in the milk stage when the corn was cut.

On September 11, the date of filling the west half of the silo, the area cut for silage yielded at the rate of 12⅔ tons per acre. The rows cut were alternate by twos or threes, with others left for filling the other half of the silo later. On the 28th, seventeen days later, the other alternate rows were cut and yielded at the rate of 12½ tons per acre. If the weight of corn on each set of alternate rows had been equal on the earlier date, there was a loss of 300 pounds per acre in the seventeen days.

A sample from each set of alternate rows was taken at the time of cutting by the chemist, Mr. Ladd, to whom the reader is referred for further information on this point.

On the lower A plats the corn was 11 to 13 feet tall, with thick, juicy stalks and very leafy. The greater part of this crop bore large ears, much of which was far enough towards ripening to begin to dent. These plats were cut October 9, and yielded at the rate of 14.4 tons per acre.

SILOS AND SILAGE.

The silos were filled as rapidly as possible with the Improved Baldwin's American Feed Cutter, run to its fullest capacity, so that the silos were filled on the second day. The plank covering was laid on without weights.

The corn was drawn from the field and weighed as fast as cut. This was done to determine the amount of fresh corn required per cubic foot of silage as put into the silo. The following table gives the cubic content of silos 14 feet 2½ inches deep, weight of corn required to fill, and weight per cubic foot:

	Cubic feet.	Weight corn, pounds.	W't fresh corn per cubic foot, pounds.
West half, filled September 11-12	794	20,552	25.9
East half, filled September 28-29	771	19,786	25.7

The last filled silo contained a bag of sorghum, the weight of which was added into above.

In filling the silo one man was kept constantly employed leveling and treading. As above stated there were no weights save the loose plank cover. On the fifteenth, after the silo had been filled 2½ days, its contents had settled together 33 inches; so now, provided not over 40 pounds of water had evaporated, the silage should weigh 32 pounds per cubic foot. The weather in the meantime was mild, the mean temperature for each day having been: 11th, 65.1° F.; 12th, 67.8° F.; 13th, 53.8° F.; 14th, 57.6° F.; mean for four days, 61.1° F.

On the 17th the silo had settled 40 inches. The settling had practically ceased the first week, as on October 5 the total was 45 inches, while the later filled silo had only settled 27 inches on that date. By the 9th it had only settled 32 inches, when it was refilled with sorghum. This difference of compacting together between the two halves of the same silo must be due to the low temperature which prevailed at the time of and immediately following the filling of the second half of the silo, preventing the proper amount of fermentation from taking place. The mean temperature for this period to October 9 was:

September 28	45.7° F.
September 29	42.6
September 30	43.6
October 1	48.3
October 2	40.
October 3	37.2
October 4	43.4
October 5	53.1
October 6	46.5
October 7	46.2
October 8	42.4
	489.0
Mean temperature	44.5° F.

The temperature of the silage must be very near the mean temperature of the days on which it was handled and the latter long period was required to heat the silage up to a point at which the change was equal to what had been reached in little more than two days in the first filled silo.

Difference of mean temperature of the two periods	16.6° F.
Difference of mean temperature of first two days	22.3°

That is, two days after filling at the higher temperature produced the same amount of settling as nine days at the lower temperature. This shows something of the influence of temperature in hastening or retarding the changes which take place in the silo.

OUT-DOOR SILOS.

In 1887 the first out-door silo in this country was made here at the instance of Mr. James Wood, of Mt. Kisco, N. Y., who also furnished a set of the levers such as are used in England for compressing the same. An account of that first silo was published in the Station Report for 1887, page 73. A further account of it is also contained in the following statement to Mr. Wood after the silo was examined and completely removed:

"The ensilage stacked in the open air in the summer of 1887 was first opened by Mr. Plumb, September 30, and its condition at that time is fully described in the Sixth Annual Report, pp 73–75.

"February 7 an examination of the remaining portion of the stack was made. The dimensions at this time being (to the cut portion) 14 x 8.5 feet by 2.5 in depth. The first foot at the top and about seven inches at the bottom was badly decayed, much of it being rotten, while the inner portion was in a condition to be eaten by the animals, although more or less moldy in places, The temperature of the interior of the stack was 108° F. The experiment can not be said to have been a success, but being opened as it was in the fall and left without further compression, together with the small size of the stack, were all against success. I have seen ensilage fed from ordinary silos in worse condition than was the interior of this stack, and had it been of two or three times the height of this one and put up in better condition (for. as stated by Mr. Plumb, the timbers proved to be too light to admit of proper compression) I have no doubt but what the experiment would have been a success.

"The apparatus for building an open air silo was received too late in the summer to permit of planting out special crops for the experiment, and only such forage crops as were available could be utilized for the purpose of putting up the silo. As stated in the report of the First Assistant, the size of the silo was much smaller than desirable, and the opening of it in the fall for examination reduced the size and gave greater exposure to the remaining portion, which was opened in February, with results as previously stated. Had the amount of material for building the silo been sufficiently large so that its depth could have been much increased, I think there is little doubt but that a much larger proportion of the silage would have come out in good condition for feeding.

"The percentage loss from decay would necessarily be larger than in a well-filled silo, but had at least double the quantity of straw been used at the bottom, and the top covered to a depth of one foot, I think the loss would undoubtedly have been much less.

"The question of open air silos is of so much importance that it would seem desirable to repeat the experiment another season on a larger scale and under more favorable conditions before pronouncing upon its feasibility as a method of storing forage crops. A circular stack would seem a more economical method for building an out-door silo, as less surface would be exposed, and I think the compression could be applied just as well as with a square one."

In the early part of September, 1888, a foundation for another out-door silo was made on nearly level ground by spiking together three sets of three 2-inch plank which were 14 feet long and 10 inches wide. These were laid up edgewise, to take advantage of the increased strength of an edgewise strain in pressing the silo, and they were placed about 3½ feet apart on low broad blocks to raise the edges a few inches above the ground. These three improvised timbers were then covered with pieces of board, plank, slabs and small joists, altogether making a bottom 10 feet square. Joists 4 x 4 inches square and 14 feet long were raised at the corners perpendicular to the bottom and stayed for guides in building the stack.

September 14, 16681 pounds of corn was put on the foundation. This built up the stack 9½ feet high.

In building the stack four boards were placed within the joists and when the filling had reached to the top edges they were raised their width. The green corn stalks were drawn fresh from the field, weighed, and piled on the stack with the buts all brought out to the board guides. In laying on the stalks great care was taken to keep the top level. This was accomplished by putting in thin layers and placing the buts of the second layer over the bent-in tops of the first, with the next two layers put on in the same way at right angles to the first. These four layers would fill about the width of the boards.

On the 15th, 6,518 pounds of sorghum was put on. The sorghum was three feet deep but raised the pile to only 10¾ feet. Then 9,406 pounds of corn were put on the last thing at night (Saturday), which raised the stack nearly to the top of the joists.

The corn was 9 to 12 feet tall and most of it bore pretty well developed ears. This fact probably made the stack more solid in the middle, hence a little crowning, and combined with the slippery character of the sorghum plants caused the top to slide off before the weighting could be done the following Monday morning.

This could not be properly replaced without removing the whole stack, so a new foundation was laid exactly like the first and the corn and sorghum which slid from No. 1, was put on it in the same way as given for building No. 1. Enough more corn was put on No. 2 from the field to make the whole somewhat more than ten feet high.

Eight or ten inches of straw was strewn over the top and partly covered with plank laid at right angles to the improvised timbers in the bottom. Three other timbers, each made in the same way of plank as those at the bottom, were then laid across the top and so braced that they would not tip down when applying pressure, and pressure applied by means of chains and the levers.

A roof with about 30 degrees pitch was then attached to the timber by which the pressure was applied so its weight was added to the pressure obtained from the levers.

Silo No. 1 was simply covered with about two feet of straw and a board roof laid on without further pressure.

At the the time silo No. 2, was being built up from the material which had begun to heat up in No. 1, the temperature was taken in many places showing that the highest degree reached and indicated by the thermometer at the time was 134° F. Exposure to the air and consequent cooling after heating up so much was considered against the good keeping of the silage.

The silos remained undisturbed until January 16, 17, 18, 1889, when they were opened and contents weighed.

In No. 1, left unweighted with an average depth of 5 feet, there was found an average depth of about 4 feet, and a body of sound fresh green silage 5 feet square by 2 feet deep. A little more was fit to use but this portion was prime silage.

In No. 2, the silage was decayed nearly two feet on the sides, but of that portion the outer 8 inches was cured and dry as fodder. Nearly 1 inch was discolored on the bottom. The top was good up to the straw. The condition of silage taken vertically from the bottom was as follows:

20 inches of bottom fresh green silage.
15 inches sorghum brown yet feedable.
20 inches corn above sorghum brown yet may be feedable.
13 inches corn at top somewhat brown yet feedable.

There was no part of the stack which could be called unfit to feed except the outside, though the browned portions had been greatly damaged by the handling and exposure after the development of heat in the rehandled mass. The damage outside calculated at 1⅔ feet amounts to about fifty per cent of the whole, while fifty per cent is left in a succulent condition nearly as acceptable to stock as green corn.

It is unfortunate that this silage had to be handled after once being put up, otherwise it would undoubtedly have been as good as the bottom 20 inches. A sample of this portion was sent Mr. Wood, who pronounced it "as good ensilage as I ever saw — nothing could well be better."

Tested in several places while being removed, the highest temperature noted on the thermometer when thrust into the side of the freshly cut down portion was 112° F. near the middle of the mass. Temperature of other parts ranged from 100° to 110° F.

A section near the bottom was cut out, weighed and found to be 36.4 pounds per cubic foot.

This can not be called a really fair trial because of the accident to the first stack, yet it demonstrates what can be done in preserving green fodder without the expense of building a silo. There are only two serious objections to the outdoor silo: First, the large proportion of loss, and second the inclemency of our climate at the time the silage is required to be fed.

The first resolves itself into whether the loss is greater than the annual interest, expense and losses on an ordinary silo, or whether this loss is greater, taking into consideration the greater value of the succulent silage, than by field curing. The expense and storage is much less than in field curing, while the weight of preserved forage will be somewhat greater than of the field cured.

One other item to cheapen the outdoor silo is the fact that the weighting is unnecessary. Our first stack the past season was without pressure other than its own weight and the top which slipped off, yet the silage preserved was quite equal in quality to that of the original stack.

A trial has been made by Mr. E. F. Bowditch, Millwood Farm, Framingham, Mass., in which he simply stacked the corn in the field during a rain storm. A trench was dug around the stack and the removed earth thrown on the top. This stack was reduced considerable in height, but yielded enough silage of good quality to be favorably reported.*

The climatic objection is more of a drawback. The silage should be disturbed only as fast as needed for feeding, since it changes quite rapidly after being removed, and it can scarcely be kept from freezing if fed from the outdoor stack every day; though a rough shelter for the side from which the silage is being taken will serve toward overcoming this objection. This seems to be the most economic form of preserving silage where mild weather prevails during the feeding period, while further trials may prove it to be so for colder climates, especially for corn preserved whole and for other plants which require less cutting, as the grasses, clovers, and other forage plants of like physical character. Also, when and where it becomes an object to keep over a stock of green food for spring and summer use. This can well be a subject of thought and foresight by every thrifty farming community.

**American Cultivator*, Vol. LI, No. 4, 1889.

The outdoor silo stack can be built up at any convenient point for spring and summer feeding to take the place of the variety of soiling crops which require so much forethought and labor in the busiest season of the year. This storing of food in a cheap form can become one of the greatest safeguards against droughts and failure of crops.

SORGHUM *(Saccharatum)*.

The crop reported above with the farm crops grew on a poor knoll where we were unable to secure more than two-thirds of a fair stand of plants, and that was so late getting a start to grow that the amount of crop produced was a surprise. This crop would undoubtedly have been doubled or trebled with favorable weather. On the plats, a trial of Link's Hybrid, Early Amber and Early Orange sorghum proved the Early Amber to be preferable here for a forage crop, owing to the others being later. Part of the crop in this trial was checked in growth for a long time, but, by frequent hoeing during the dry weather, it started to grow again earlier than in the large field, and from part of the 6 plats the yield was, when cut for the silo, at the rate of 22.9 tons per acre.

One-half of the old silo will be filled with this crop another season, if the small amount now in silo comes out well, and a good crop can be grown for the purpose.

ALFALFA, OR LUCERNE *(Medicago Sativa)*.

This valuable forage plant has been cultivated on the Station plats since 1882 and reported upon favorably, hesitatingly at first, but with more confidence as its tenacity of life and heavy crops produced carried the conviction that it is one of the profitable forage crops for New York. Writers cling to the recommendation of sandy soil for alfalfa, but here on stiff clay it has thrived since 1882 on the original seeding. Later seedings have yielded well, and to all appearances it is perfectly hardy when well established. It is a little difficult to get a perfect "stand," and makes a slow growth the first year. Hence, weeds are apt to choke it; but if past its first season, dairymen can depend on a fair clover crop from it for several years in succession.

The two original plats of 100 square feet and the 2-35 acre on A gore have yielded as follows the past season:

	West 100 sq. feet, lbs.	East 100 sq. feet, lbs.	A gore, lbs. per acre.
June 16, yield at rate of	19,384	18,513	Green, 12,250
July 18, yield at rate of	6,751	5,227	Dry, 3,789
September 24, yield at rate of	5,009	5,009	Dry, 3,013
	31,144	28,749	....

Besides these plats, the cherry orchard and a strip in field D have been cut three times and yielded considerable amounts of green forage and hay.

The second cutting on the cherry orchard amounted to 1,584 pounds of hay on .97 acre. Late the past season these plats were top-dressed, and it is proposed to give them another dressing in spring. This should stimulate them to better results than have hitherto been attained without manuring.

PRICKLY COMFREY *(Symphytum asperrimum).*

The plat set and reported upon last season* was top-dressed and cultivated early in the spring, and after each cutting except the last. It has continued to yield well and has been supplemented by a new setting of 1-10 acre. Plat B 1 was planted April 26 from cuttings purchased of Dr. Foster, Clifton Springs, New York. The rows in the new setting are 3 1-3 feet apart, with the roots set 18 inches apart in the row. This plat has been top-dressed once, and cultivated frequently during the season. The plants showed quite a tendency to blossom, but were not cut back until July 11, the date of second cutting on the older plantation, when it was cut as close to the ground as could be conveniently done with a grass knife. Below are dates of cutting on both plats, and the rate of the harvest weight per acre, except for the first cutting on A, the memorandum of which was lost.

	A 14, upper.	B 1, upper and lower.
June 5	Wt. lost.	
July 11	8,052 lbs.	1-2 6,280 lbs. green. 1-2 940 lbs. air dry.
September 19	13,486 lbs.	11,105 lbs. green.

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*Station Report 1887, page 72.

At the second cutting of the A plats, several plants were left standing to ripen seed. Although the plants blossomed freely and continuously, comparatively few seeds were saved. The ovary early separates into four distinct lobes, one to three of which often prove abortive. The fruit is a nutlet which easily separates from the receptacle, hence the tendency to shatter will render any attempt at propagation from seed unprofitable.

Trials this season in both directions indicate that the plant is of no value for hay or ensilage. Its value as an agricultural plant is therefore confined to the soiling system. It appears to be a valuable addition to our list of soiling crops. The Station cows have eaten heartily of it whenever offered to them, and they have consumed the entire crop, except the portions which were used in trials for hay and ensilage.

GRASSES ON SMALL PLATS, 1888.

Brief notes on the appearance and condition of those grasses and clovers which, previously grown, survived the winter:

Agropyrum glaucum. Ag-ro-py′-rum glau′-cum. (Blue Stem.)

Only a few stems left on plat.

Agropyrum repens. Ag-ro-py′-rum re′-pens. (Couch, Quake, Quick, Quack, Witch, Wheat, Twitch, Quitch, Tommy, Dog, Chandler, and Squitch Grass.)

Flourishes as a weed. No plat devoted to it.

Agrostis canina. A-gros′-tis ca-ni′-na. (Brown Bent, Dog's Bent, Mountain Red Top.)

Some bare spots; also bare at one end; turf fair.

Agrostis stolonifera. A-gros′-tis sto′-lon-if′-er-a.

Fairly turfed.

Agrostis vulgaris. A-gros′-tis vul-ga′-ris. (Red Top, Herd's G. in Penn., Fine-top, Burden's, Bent, Rhode Island Bent.)

Grass enough on three plats to turf one well.

Alopecurus agrestis. Al-o-pe-cu′-rus a-gres′-tis.

Plat half covered with small stool.

Alopecurus pratenis. Al-o-pe-cu′-rus pra-ten′-sis. (Meadow Foxtail.)

Strong, vigorous turf in rows.

Anthoxanthum odoratum. An-thox-an′-thum o-do-ra′-tum. (Sweet Vernal, Sweet Scented Vernal.)

Small size and in stools. Plat mostly covered with oat grass, which has spread by seed.

Arrhenatherum avenaceum. Ar-rhen-a-the′-rum a-ven-a′-ce-um. (Evergreen, Tall Oat, Meadow Oat G.)

Stooled and nearly half bare.

Avena elatior. A-ve′-na e-la′-ti-or. (Tall Meadow Oat Grass.)

In rows, tufted and vigorous.

Bouteloua oligostachia. Bou-te-lou′-a ol-i-gos-tach′-ya. (Mesquite or Buffalo G.)

Rather thin turf.

Bromus pratensis. Bro′-mus pra-ten′-sis.

Plat three-fourths covered with small stools.

Calamagrostis. (See Deyeuxia.)

Dactylis glomerata. Dac′-tyl-is glom-er-a′-ta. (Orchard Grass.)

In rows thick and vigorous.

Deschampsia cæspitosa. Des-champ′-si-a cæs-pi-to′-sa. (Hair Grass.)

In rows thick and vigorous.

Deyeuxia sp? De-yeux′-i-a. (Mountain Blue Joint.)

Plat one-fourth covered with stools.

Festuca. Several species and many varieties of this very variable grass.

Festuca elatior. Fes-tu′-ca e-la′-ti-or. (Tall Fescue.)

Turf poor and mixed.

Festuca ovina. Fes-tu′-ca o-vi′-na. (Sheeps' Fescue.)

Turf good, but with mixture.

Festuca ovina, var. duriuscula. Du-ri-us-cu′-la. (Hard Fescue.)

Turf fair, but rather thin. Stooled.

Festuca ovina, var. rubra. Ru′-bra. (Red Fescue.)

Turf stooled but quite vigorous.

Festuca ovina, var. heterophylla. Het-e-ro-phyl′-la.

Fine tufted turf.

Festuca pratensis. Pra-ten′-sis.

Lolium Paceyii. Lo-li-um Pa-cey-ii. (Pacey's Rye Grass.)

Partly winter-killed; stools of other grasses mixed in.

Lolium perenne. Lo′-li-um pe-ren′-ne. (Rye G., Italian Rye G.)

Medium turf, not up to average.

Phalaris arundinacea. Phal-a′-ris a-run-di-na′-ce-a. (Reed Canary, Ribbon.)

Good strong growth.

Phleum alpinum. Phle′-um al-pi′-num. (Mountain Timothy.)
Stooled; plat nearly bare on one side; turf fair; a few days earlier than common Timothy.

Phleum pratensis. Phle′-um pra-ten′-sis. (Common Timothy.)
Much better turf than Mountain Timothy.

Poa aquatica. Po′-a a-quat′-i-ca. (Water Meadow Grass.)
Part of plat bare; stems rise through soil without much turf.

Poa nemoralis. Po′-a nem-o-ra′-lis. (Wood Meadow Grass.)
Two-thirds of plat in stools; remainder bare.

Poa pratensis. Po′-a pra-ten′-sis. (June G., Kentucky Blue G.)
Good thick turf on whole plat.

Poa trivialis. Po′-a triv-i-a′-lis. (Rough Stalked Meadow G.)
Cultivated in rows which are strong turf.

Stipa spartea. Sti′-pa spar′-te-a. (Porcupine Grass.)
In stools as though set in hills. Apparently some new plants springing from seed.

Triticum. (See Agropyrum.)

——— ———. (Bennett's Native Wild Rye Grass.)
Turf fair.

——— ———. (Fort Bellingham Grass.)
Very good turf. Near borders best of plats.

CLOVERS.

Meliotus alba. Mel-i-o′-tus al′-ba. (Bokhara Clover.)
Abundant new growth and much old straw; a small portion of plat infested with sorrel.

Medicago sativa. Med-i-ca′-go sa-ti′-va. (Alfalfa or Lucerne.)
Plants in rows, but numerous and healthy.

Trifolium repens. Tri-fo′-li-um re′-pens. (White Clover.)
Ground well covered with vines.

Additional Grasses Grown in 1888.

Sorghum halapense. Sor-ghum hal-a-pense. (Johnson Grass.)

Bromus secalinus. Bro′-mus se-cal′-i-nus. (Chess, Cheat.)

Panicum proliferum. Pan′-i-cum pro-lif′-e-rum. (Crab Grass.)

Bromus Schraderii. Schra-der-ii. (Schrader's Brome Grass.)
From scattered seed of last year's growth left on plat and raked in.

Cynosurus cristatus? Cyn-o-su-rus cris-ta′-tus. (Crested Dog's-tail Grass.)

——— ———. Not determined. (Bennett's Native Wild Rye Grass.)

——— ———. Festuca pratensis? (Fort Bellingham Grass.)

Several varieties of millet and Hungarian grass were grown under the names of Setaria Italica, Panicum Italicum, Setaria Germanica, Panicum Germanicum, Pearl Millet, German Millet, Hungarian Grass, etc. These names have become so mixed as to be quite indefinite.

Additional Clovers.

Onobrychis sativa. On-o-bry-chis sa-ti-va. (Sainfoin, or English Cow Grass.)

Medicago maculata. Med-i-ca′-go mac-u-la′-ta. (Burr Clover.)

Trifolium incarnatum. Tri-fo′-li-um in-car-na-tum. (Crimson Trefoil or Scarlet Italian.)

T. hybridum. Hy-brid-um. (Alsike Clover.)

T. pratensis. Pra-ten′-sis. (Common Red Clover, Peavine Clover.)

T. medium. Me′-di-um. (Medium Red Clover.)

Some of the above grasses are so well known and generally cultivated as to require no recommendation from any source to the practical stockman. There are several which in earliness and other good qualities seem well fitted to rank with the favorite Timothy. The best of these for hay are Fescuta elatior and pratensis, Dactylis glomerata and Avena elatior. For early hay, where the stubble is to be grazed, there seems to be no grass which can equal Poa pratensis, and Alopecurus pratensis is well fitted to take a place in the good pasture grasses.

June Grass (Poa pratensis) has come into disrepute in most sections of the Northern States as a field or pasture grass. This is chiefly due to its early ripening, after which there is only a small crop of wiry hay. Cattle will wander over it when ripe, standing 15 to 24 inches high, searching for something to eat. When cut at an early stage of growth, soon after the panicle is grown or when in blossom, or if fed off close at that time its leaves will go on growing from the base all the season, and in that way it yields an incredible amount of pasturage. This grass makes the strongest of turfs, and cattle are less liable to do injury with their feet, if grazing when too wet, than on most other turfs.

The less well-known grasses which seem to promise to yield large crops and to be available for hay are:

Sorghum halapense, which with meliotus makes an excellent hay in Mississippi. It grows here as an annual, but may undoubtedly be cut twice in one season by careful management and under very favorable circumstances. It is to be tried on a larger scale.

Phalaris arundinacea, although a coarse and rather harsh grass, starts early and is a rank grower and seems to be perfectly hardy here. It makes a rapid growth early in spring, and has been eaten once (the only time offered to them) with relish by the Station cows. It can spread by its stout root-stalks, and might become a troublesome weed on that account if introduced where not wanted permanently. However, no such trouble has been experienced with it yet.

The new clovers have made a good thick growth, especially T. incarnatum and T. maculata. The former may not survive the winter in this latitude, since it is a sub-tropical plant. It blossomed and would have yielded quite a crop if it had been cut seasonably.

Seeds were saved from nearly all the small grass plats.

LARGE GRASS PLATS.

These plats were seeded to grass in 1886. The mixtures of seed were presented by Daniel Batchelor, Esq. They are given below, with the appearance of growth and turf, at the opening of the season of 1888.

No fertilizer was used in preparing the seed bed, and no application of any kind was made until after the 1888 hay crop was cut.

Mixtures Sown and Condition Early in Spring.

A 1, upper..	Perennial Rye Grass, Alsike Clover.....	1-5......	Clover started fairly but thin. Grass either very late to start or winter-killed. Quack has a foothold in spots.
A 2, upper..	Water Meadow Grass, Red Top..	1-2 each..	Turf fair except southeast corner which has many bare spots.

A 3, upper..	Kentucky Blue Grass, Meadow Fescue...	1-2 each..	Turf very good; some quack and clover coming in.
A 4, upper..	Italian Rye Grass, Timothy.........	1-2 each..	Turf fairly good; some clover coming in.
A 5, upper..	Spiked Fescue, Sweet Vernal.....	1-2 each..	Ditto No. 4.
A 6 upper..	Pacey's Rye Grass, Various-leaved Fescue Grass.....	1-2 each..	Nearly all dead from winter-killing; clover stools numerous.
A 7 upper..	Orchard Grass, Meadow Fescue Grass...........	1-2 each..	Turf in fair condition; borders better than middle.
A 8 upper..	Wood Meadow Grass, Creeping Bent Grass......	1-2 each..	Many bare spots occur, and there are numerous weeds and stools of other grasses. Not a good turf.
A 9 upper..	Yellow Oat Grass, Meadow Foxtail Grass...........	1-2 each..	Poor turf; many bare spots.
A 10 upper.	Crested Dogstail Grass, Purple Fescue Grass.......	1-2 each..	Turf good; the ratio of Fescue has evidently increased,some clover and quack grass coming in.
A 11 upper.	Rough-Stalked Meadow Grass, Foul Meadow Grass..........	1-2 each..	Other grasses have come into this plat to a considerable extent. Quack vigorous on one side and end, and white clover on the other end.

A 12 upper.	Italian Rye, Red Top, Timothy, Tall Fescue, Meadow Foxtail, Perennial Rye, Yellow Oat Grass	1 lb. each.	Rather poor turf, but better than next.
A 13 upper.	Rough-Stalked Meadow, Sweet Vernal, Crested Dogstail, Various Leaved Fescue, Pacey's Rye, Poa pratensis, Meadow and Various Leaved Fescues....	1 lb. each.	Poor turf; shows winter-killing; shows stools of clover scattered over plat.

HAY FROM ABOVE PLATS, 1888.

PLAT.	Date of cutting.	Actual yield, lbs.	Yield per acre, lbs.
A 1 upper	July 3	148	3,256
A 2 upper	June 22	102	2,244
A 3 upper	June 22	124	2,728
A 4 upper	July 3	114	2,508
A 5 upper	June 22	86	1,892
A 6 upper	June 22	29½	649
A 7 upper	June 21	103	2,266
A 8 upper	June 19	79	1,734
A 9 upper	June 19	76	1,672
A 10 upper	June 19	92	2,024
A 11 upper	July 3	128	2,816
A 12 upper	June 21	175½	3,861
A 13 upper	June 21	59	1,298

It was the intention to cut all the plats at the same stage of growth, but dull weather during the last week of June made the clover harvest late by ten days.

Since the hay was cut, all the grass plats have been top-dressed with well-rotted yard manure, and the shady, moist weather, combined with the effect of the manure, has strengthened the turf and produced a good aftermath for winter protection to the roots.

FERTILIZER EXPERIMENT ON GRASS.

One-sixth acre plats were laid off across the division fence between two fields, F and G, so that each field included one-half of every plat. The fertilizers were sown April 26. During the spring and early summer the weather seemed very favorable to the growth of grass, being cool and moist through May.

The growth on field F was clover and timothy, with by far the larger portion of clover, except on some of the plats. On field G timothy was the predominant grass, and there was a small amount of clover.

As the growth increased, it became evident that the nitrogenous fertilizers were exerting a very marked influence on the grass of field F, though the clover was not noticeably increased on any of the plats. On field G the increase was similar, but less marked, though the outline of those plats where nitrogenous fertilizer was used could be traced from a considerable distance.

The following tables give, for both fields, the kind of fertilizer, amount and cost of each; hay harvested from the plats and the per cent of increase, where there was any, due to fertilizers:

TABLE I.

FERTILIZER AND SOIL TEST — FIELD F.

Plat.	NAME OF FERTILIZER.	Fertilizer used on 1-12 acre, lbs.	Cost per pound, cents.	Cost per plat, dollars.	Hay harvested, lbs.	Per cent increase over unmanured.
a	Sodium Nitrate	40	2.5	$1 00	381	70.
b	Ammonium Sulphate	26⅔	3.5	.93⅓	342	53.
c	Barnyard Manure	†	......	*.62½	206	....
d	Potassium Nitrate	23⅓	6.0	1 40	307	37.
e	Unmanured	......	......	....	227	....
f	Potassium Sulphate	33⅓	1.5	.50	232	4.
g	Muck	†	......	*.25	210¾	....
h	Dissolved Bone Black	33⅓	1.3	.43⅓	258	16.
i	Dissolved Bone Black Potassium Sulphate	33⅓ 33⅓	1.4	.93⅓	268	20.
j	Unmanured	......	......	....	220	....
k	Dis. Bone Black 16⅔ Sodium Nitrate 20 Potassium Sulphate 16⅔ Ammonium Sulphate 13⅓	66⅔	2.15	1 44	332	49.
l	Gypsum	66⅔	0.4	.26⅔	188	....
m	Special for Winter and Spring Grain,	21	......	....	220	....
n	Soluble Pacific Guano	21	......	....	204	....
o	Unmanured	......	......	....	....	....

* About net cost when purchased in town.

† One horse load.

TABLE II.

FERTILIZER AND SOIL TEST — FIELD G.

Plat.	NAME OF FERTILIZER.	Fertilizer used on 1-12 acre, lbs.	Cost per pound, cents.	Cost per plat, dollars.	Hay harvested, lbs.	Per cent increase over unmanured.
a	Sodium Nitrate	40	2.5	$1 00	388	9.
b	Ammonium Sulphate	26¾	3.5	.95	446	26.
c	Barnyard Manure	*	....	†.62½	364	3.
d	Potassium Nitrate	23⅓	6.	1 40	378	7.
e	Nothing	....	....	......	327	......
f	Potassium Sulphate	33⅓	1.5	.50	350	......
g	Muck	*	....	†.25	353	......
h	Dissolved Bone Black	33⅓	1.3	.43	378	7.
i	Dissolved Bone Black Potassium Sulphate	33⅓ 33⅓	1.4	.83	410	16.
j	Nothing	....	....	......	383	......
k	Dis. Bone Black 16⅓ Sodium Nitrate 20 Potassium Sulph. 16⅔ Ammonium Sulphate 13⅓	66⅔	2.15	1 44	435	23.
l	Gypsum	66⅔	0.4	.26⅔	290	......
m	Special for Winter and Spring Grain,	21	....	......	276	......
n	Soluble Pacific Guano	21	....	......	287	......
o	Nothing	....	....	......	......	......

DISCUSSION OF RESULTS.

In laying down these plats the intention was to take the average of the three unmanured as a mean for comparison with those receiving various manures. There was a mistake in harvesting, and the products of the two O plats were weighed together. Fertilizers on plats M and N were not sown for some time after the others; hence any comparison with them now would be unfair and misleading. The comparison of yield from the F field plats shows a very marked increase of crop from the application of nitrogen in each of the three forms used, but sodium nitrate gives a much higher per cent over the unmanured than either ammonium sulphate or potassium nitrate, which gave the lowest yield of the three, although it has potash in combination with its nitrogen. Potash alone gave too small an increase to be considered.

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* One horse load.

†About net cost when purchased in town.

Phosphoric acid gave enough increase, 16 per cent, to indicate that it would be helpful in increasing the crop, and when combined with potash the increase was equal to the sum of the increase of both alone, but the increase was only about half that realized from the potassium nitrate. With the combination of all three of the elements the yield was less than the mean yield from an equal amount of nitrogen alone.

In field G ammonium sulphate gave the greatest increase, 26 per cent, and the three elements combined gave 23 per cent increase over the two unmanured plats, E and J. Sodium nitrate and potassium nitrate yielded an increase of only 9 and 7 per cent respectively, which may be a difference due to local peculiarities in the several plats, and not to the fertilizers applied.

Phosphoric acid alone increased the crop by 7 per cent, only about two-fifths as much as on field F. When combined with potash the per cent of increase was more than double, although potash alone did not give as much crop as the mean of the unmanured plats.

Conclusions: From these results one can draw only limited conclusions:

1st. That in field F nitrogen in its most soluble form was preëminently the special fertilizer to increase the growth of grass under the conditions of this season.

2d. That the other elements can not be said to have exerted a positive influence on the crop, although when combined they did give a yield somewhat above a generous allowance for errors.

3d. That muck and the rather poor quality of manure available were unprofitably employed as a top-dressing for this one crop.

4th. In field G nitrogen makes by far the greatest increase, but the results do not indicate that a single element can be profitably used.

5th. Sodium nitrate in field F was the only fertilizer from which a profitable return was realized.

FERTILIZER EXPERIMENT IN FIELD D — OATS.

The question here is: What elements, or combination of fertilizing elements, does this field require in order to produce the largest or most profitable crop?

The part of the field devoted to oats is 918 feet long from east to west, and strips of one-fifth of an acre in area require the 8-tube Empire drill to sow with one end tube shut off, so the plat consists of 14 rows 918 feet long.

To separate these plats so that no influence of the fertilizer sown on one should be felt on the adjacent plats, a strip of seven rows (one width of drill) was sown between plats without fertilizer, and with a blank row on each side between the plats and intermediate strip. The oats and fertilizers were drilled in May 5th and 7th.

The different fertilizers and amounts of each applied to these plats are given in the table below.

In all cases where the fertilizer was not all distributed when the grain was sown, the grain was shut off and the drill driven over the ground again. This, with cleaning the box and the distributing cups after every lot, so delayed the work that five plats were left unsown over Sunday and the sowing completed on Monday.

When the oats vegetated it was noticed that two rows on the four plats L, M, N and O were blank from the clogging of tubes. As rain had fallen and softened the surface, these two rows were drilled over again as soon as the condition of the ground would permit.

Extracts from Notes Taken on Growth.

June 2. Oats on plats H and I appear to lead in growth.

June 18. Oats of plats A, B, C, D and K seem to be about equal in development and lead all the others, while H and I are noticeably larger than adjoining strips.

June 19. At this date oats on plats A and B and intermediate strips are recorded as being in watery milk stage.

Oats on D were passing to white milk stage.

Oats on C, E, F, G, H, I, J and K in white milk stage. K is darker green and less turned than others.

The other four plats have green strips due to late replanting, but the main part of each was as follows:

Oats on L very watery.

Oats on M more forward than on L.

Oats on N more forward than on M.

Oats on O nearly same as N, but turned more and have made shorter growth.

July 27. The intermediate and unmanured strips and plats are changing color about even with the main field.

Oats on plats A, B, D, are greener and behind in turning.

Oats on plats C, E, F, G, J and O are ripening about with strips and field.

Oats on plat H apparently ripest plat.

Oats on plat K have made a ranker growth and are about intermediate between the greener and riper plats.

Oats on plat L have turned less than on K.

Oats on plat M have turned rather more than on the adjacent intermediate strips.

Oats on plat N have turned nearly as on O.

The oats were harvested August 7 and 8. They were cut with a self-binding reaper which made two swaths of each plat, cutting as wide as the drill sowed. The grain was then set up, each lot on its own plat, and stood there, with two resettings to hasten the drying, until it was threshed August 28.

The grain and straw from each plat was weighed and the grain cleaned in a hand mill, after which it was weighed as "clean grain" and "screenings," and the difference between the sum of these and the first weight added to "straw and chaff" to make up that column in the following table:

FERTILIZING EXPERIMENT WITH OATS — CROP ON OAT PLATS — FIELD D, 1888.

Plat.	NAME OF FERTILIZER.	Am't used, lbs.	Am'nt per acre, lbs.	Cost per plat.	Value of increase over un-man'red	Total harvest w't.	Cleaned grain.	Weight of str'ck h'lf bush.	Screen'gs.	Straw and chaff.	Per cent of crop straw and chaff.	Lbs. straw to 100 lbs. cl'n grain
a	Sodium Nitrate........................	60	300	$1 50	$ .41	811¼	363½	14	24¼	423½	52.2	116
b	Ammonium Sulphate..................	50	250	1 75	.59	841½	375	14	12¾	453¾	53.9	121
c	Animal Manure	*	†	1 25	.98	912¾	413¾	14	18¼	480¾	52.6	116
d	Potassium Nitrate	70	350	4 20	.19	798¾	354½	13¾	14¾	429½	53.7	121
e	Nothing	......	......	....	....	822½	379	14½	17	426½	51.8	112.5
f	Potassium Sulphate	80	400	1.20	.13	800½	345½	13½	16	439	54.8	127
g	Muck	*	‡	.75	—.12	753¼	331½	14	16½	405¼	53.8	122
h	Dissolved Bone Black.................	60	300	.80	.72	874¼	393¼	15	21¾	459¼	52.6	116.7
i	Dissolved Bone Black................. Potassium Sulphate	60 60	300 300	2.00	1.02	923½	414½	15¼	18¼	490¾	53.1	118.4
j	Nothing	......	......	....	....	740¾	307¼	14½	23	410½	55.1	133.6
k	Dissolved Bone Black................. Potassium Sulphate .... Sodium Nitrate .... Ammonium Sulphate	60 80 30 25	300 400 150 150	3.62	.32	867¾	339½	14¾	29¾	498½	57.4	146.8
l	Gypsum	120	600	.48	—1.30	621	224¼	13¾	18¾	378	60.9	168.6
m	Empire State Brand....................	60	300	....	—.17	719	336¾	15½	19¾	362½	50.4	107.6
n	Special for Winter and Spring Grain..	60	300	....	.70	925½	369¾	16¼	23½	531¼	57.4	143.7
o	Nothing	......	......	....	....	800¼	305½	15¼	21¾	473	59.1	154.8

* One 2-horse load. † Five 2-horse loads. ‡ Seven 2-horse loads.

Discussion of Results.

It will be seen by the above notes that plats L, M, N and O were thrown out of a fair comparison by the late replanting of two rows in each.

The rainfall for the first twelve days after sowing the oats amounted to $1\frac{3}{8}$ inches. This precipitation came mostly in light showers. Only once, on the 12th, was there fall enough to have carried the nitrate down below the reach of oat roots, even if that were sufficient. Again on the 19th, 25th and 29th there were considerable falls which could have helped materially to hold the main portion of the nitrates down below the reach of the roots.

Whether this was the case or not, the easily soluble nitrogenous manures on plats A, B and D did not seem to have any effect on the growth up to June second, but two weeks later, after a comparatively dry period in which the direction of the soil water movement was undoubtedly upward, they were, with plats C and K, leading the field in size and in the dark green color of the leaves.

These plats held the leading position in growth throughout the remainder of the season, and the straw was somewhat green at harvest. That of plat D was a little later than either of the two on which only nitrogen was applied. Plat K occupied nearly an intermediate position between the above nitrogen manured plats and plats C, E, F, G and J, which ripened uniformly with the intermediate strips on the north part of field which was sown on the same day.

The oats on plat H ripened faster than on any other, and were closely followed by those on plat I. The two ripened so much ahead of others as to be noticed by the most casual observation.

The oats on plats K, L, M, N and O, and the south part of the field were sown two days later than the other plats and north portion. A part of this south portion contains a shallow "run," or hollow, in which the oats grew very rank, and there was consequently less evenness in ripening than on the north part of the field. This hollow did not reach the plats; hence only the comparison of growth is affected by it.

Of the oats on these plats, M and N were rather in advance of the better ripened portions of the south part of the field, but showed some green in the straw, indicating that they were some days later than on the north side of the field, though the kernels seemed to be nearly as firm as on the ripest plats.

The crop on plats L and O was rather later than that on the south part of the field. This discussion is not intended to include the two green rows which were drilled in so much later.

Thus nitrogenous manure had the effect to increase the size and green color of straw, and to lengthen the growing period, or, in other words to retard ripening; while phosphoric acid had its effect in hastening the ripening of the crop.

Neither muck, potash nor gypsum had any noticeable effect on the appearance of the crop.

A perfectly fair comparison of all the plats can hardly be made, as they were not all sown on the same date, and because of the two late sown rows on the four plats L, M, N and O. But on comparing the means of the unmanured plats E and J with E, J and O, the latter mean differs from the former only by slight differences which are corrective in their tendency, and using the mean of the three is also more favorable to the manured plats in an economic comparison. In this comparison straw is reckoned at 30 cents per 100 pounds, and oats 33⅓ cents per bushel, or $1.04 per 100 pounds, and screenings at half the price of oats. Not one of the manured plats produced enough more than the mean of the three unmanured plats to pay for the fertilizer used.

By raising the value of oats to 40 cents per bushel the phosphoric acid on H paid for itself, but there was still a deficit of 9 cents for the manure on C, the next best plat, both in relative value of crop to cost and in total amount of crop. The greatest increase of crop — from plat I — returned only .6 of the cost of the fertilizer. Although the oats were very dry at the time of threshing, only one plat yielded grain of standard weight, which is in harmony with the observations of previous years that the oats raised on this farm have been light. The ratio of straw to grain was 127 to 100.

FERTILIZER EXPERIMENT IN FIELD E. — KING PHILIP CORN.

This field produced a crop of hay in 1887. It received a dressing of muck and manure composted the following spring at the rate of thirty loads per acre. This dressing was plowed in May 10-16. The ground was harrowed several times, rolled and reharrowed, but the heavy clay refused to come into good condition for a seed bed, and it was rather rough and lumpy when planted, May 25. The heavy roller was run over it the next day, and a light rain following before morning gave the seed a good chance to grow. The corn rows were obliterated by rolling, and remained so until the corn was up.

On June 6th, it was harrowed lengthwise the rows, with a slant-toothed smoothing harrow, which effectually set back the grass which was showing up all over the field.

The fertilizers were sown, and muck and manure applied on the 8th.

The following gives the kind and amount of fertilizer used per plat and per acre:

FERTILIZERS APPLIED.

Plat.	NAME OF FERTILIZER.	Amount used, lbs.	Amount per acre, lbs.
A........	Sodium Nitrate...	80	480
B........	Ammonium Sulphate	53½	320
C........	Animal Manure...	*	†
D........	Potassium Nitrate...	46⅔	280
E........	Nothing	....	....
F........	Potassium Sulphate...	66⅔	400
G........	Muck	*	†
H........	Dissolved Bone Black...	66⅔	400
I........	Dissolved Bone Black...	66⅔	400
	Potassium Sulphate...	66⅔	400
J........	Nothing	....	....

* One two-horse load. † Six two-horse loads. ‡ Two-horse loads.

FERTILIZERS APPLIED — (*Continued*).

Plat.	NAME OF FERTILIZER.	Amount used, lbs.	Amount per acre, lbs.
K........	Dissolved Bone Black	33⅓	200
	Potassium Nitrate	33⅓	200
	Sodium Nitrate	46	240
	Ammonium Sulphate	26⅔	160
L........	Gypsum	133⅓	800
M........	Winter and Spring	42	252
N........	Soluble Pacific Guano	42	252
O........	Nothing	....	....

The plats were hoed once lengthwise and once crosswise. The only difference between the treatment of these plats and the main field was an extra hoeing on the north edge, where a persistent growth of grass made extra work necessary.

Care was taken to hoe all the plats in one day, or, in hoeing across, to do the same amount of work on all of them on the same date.

Notes were made on growth and relative appearance at different times during the season.

Very little difference could be noted in appearance and growth, though it was early noted that there was a gradual change from south to north, so that the corn on the north side did not look so well as on the south side. It must be remembered the plats of two rows each extend east and west, and that they are lettered from A on the south side to O in the middle of the field. Plats A to H showed no difference except that corn on row 1, in plat C was shorter and poorer than that on adjacent rows owing to its being in, and near the dead furrow.

Corn on row 2 of plat I, and the adjacent intermediate strip were poorer than their neighbors from the same cause. These exceptions disappeared on the west ends of the rows, where no effects of dead furrows could be seen.

Near the west ends and across the middle of the plats there was a spotty appearance and some poor areas which bore no relation to the present plats. There were also some spots which seemed to be more thrifty than their surroundings.

Later in the season the remarkably even appearance of these plats, barring the spots noted above, was noted and pointed out as below, as viewed from the east end, while from the west end the general appearance agreed except that the corn on row 1 of plat C was comparatively better, since the intermediate row appears to be here in the dead furrow.

The poor spots noted above were on plats C, D and E near southwest corner, further east on A, B, C, D and E.

These are all on division 4 of the duplicate areas.

Another poor spot occurred on B, C and D of division 3, and one on M, N and O of division 2.

A careful count was made of the stand of corn, both hills and stalks, before harvest. The differences were found to be seven in a total of 460 to 467 hills, where a perfect stand called for 470. The stalks varied more, as would be expected. The range was from 1,990 to 2,125.

The suckers had been removed, and where more stalks grew they had been reduced to five; hence a full stand of 5 stalks would have been 2,350 per plat. Plats J and K bore the fullest stand, 2,125, while A and I bore the least, 1,990 and 1,992 respectively. From this data it would be easy to calculate all to a perfect stand, but for the purposes of this experiment it seems best to use only what was actually produced on each plat without reducing to a perfect stand in like proportion to what each actually produced.

On September 22, the date of cutting up, passing across the plats from south to north one could not say that any one row was riper than another, but there seemed to be a gradual shading to greener stalks and ears toward the north, which was noticeable only after several plats were passed.

The corn was husked between October 26 and November 1. The husking was done across the plats, completing one-fifth of all the plats in one day before moving forward to the next fifth. This method was followed in order to accommodate a cultivation experiment and to give duplicate portions of each plat.

The following table gives the total yield, sound and soft corn, and stover by difference; the number of bushels per acre, and weight of stover for each 100 pounds of sound corn:

CROP ON PLATS, FIELD E (KING PHILIP CORN), 1888.

PLAT.	Total weight. Lbs.	Total corn. Lbs.	Stover. Lbs.	Sound corn. Lbs.	Soft corn. Lbs.	Bushels per acre, 80 lbs. per bushel.	Stover per 100 pounds sound corn, lbs.
A	1,761.25	831.50	929.75	797.00	34.50	59.8	116.
B	1,726.50	840.25	886.25	792.75	47.50	59.5	112.
C	1,405.25	708.25	697.00	637.75	70.50	52.3	109.
D.	1,737.00	886.25	850.75	850.00	36,25	63.8	100.
E	1,624.25	824.50	799.75	775.00	49.50	58.1	103.
F	1,660.75	858.00	802.75	815.50	42.50	61.2	98.4
G	1,651.00	847.25	803.75	806.00	41.25	60.5	99.7
H	1,672.00	870.75	801.25	825.00	45.75	61.9	97.
I	1,292.75	672.75	620.00	607.25	65.50	45.5	102.
J	1,667 00	875.50	791.50	823.50	52.00	61.8	96.
K	1,719.75	854.25	865.50	799.25	55.00	59.9	108.
L	1,589.50	832.75	755.75	787.25	45.50	59.	96.
M	1,643.75	819.25	824.50	776.50	42.75	58.2	106.
N	1,435.00	758.75	676.25	703.50	54.25	52.8	96.
O	1,552.37	811.00	741.37	762.25	48.75	57.2	97.
Mean of three unmanured	1,614.54	837.	777.54	786.92	50.08	59.	99.
Mean of all	1,609.14	819.4	789.74	770.57	48.77	58.1	102.4

This crop is so uniformly good that there is but one conclusion to draw: With the thirty loads of manure per acre plowed in, the corn was so well fed that a further application was unprofitable and its effect scarcely noticeable, although there was, on the whole, a somewhat larger crop per acre than on the remainder of the field. There seems to have been an increase in the ratio of stover to sound corn from the plats which received nitrogen alone. This is in accord with the influence of nitrogen on our other plats.

The most important and interesting part of this experiment is its bearing on the selection of plats which shall represent the field in which they are located. Being in strips extending across the whole field, they offer a fine opportunity for testing the relative fertility of different portions of the field, or, in other words, the fallacy of using small plats and generalizing on the evidence of data so obtained.

As above noted, each plat was harvested in five equal portions, hence we have fifteen series of five duplicates each, of one-thirtieth of an acre extending across the field. The duplicates have been fertilized alike, and treated alike in all other respects, except, that when the field was hoed across from north to south, some one or two days intervened between the hoeing of the first and last of the five. That difference in treatment may have some influence on the crop, but it can not account for the differences of yield, especially when it is further noted, that cultivation strips of one acre each, under the same treatment, failed to show any differences worthy of note.

Following are tables showing the yields from these duplicates on each plat in detail:

SHOWING VARIATIONS IN FERTILITY OF SECTIONS OF PLATS.

One-thirtieth Acre in each Section.

Number of duplicate from east.	PLAT A.						PLAT B.						PLAT C.					
	Total weight, lbs.	Total corn, lbs.	Stalks, lbs.	Sound corn, lbs.	Soft corn, lbs.	Sound corn per acre, bushels.	Total weight, lbs.	Total corn, lbs.	Stalks, lbs.	Sound corn, lbs.	Soft corn, lbs.	Sound corn per acre, bushels.	Total weight, lbs.	Total corn, lbs.	Stalks, lbs.	Sound corn, lbs.	Soft corn, lbs.	Sound corn per acre, bushels.
0.........	392.00	184.00	208.00	176.50	7.50	66.2	446 50	207.00	239.50	197.00	10.00	73.9	341.25	172.00	169.25	152.25	19.75	57.1
1.........	438.50	192.50	246.00	185.50	7.00	69.6	430.50	207.75	222.75	201.75	6.00	75.7	314.00	158.50	155.50	145.00	13.50	54.4
2.........	376.75	182.50	194.25	179.25	3.00	67.2	352.25	164.00	188.25	157.75	7.00	59.2	271.50	136.75	134.75	129.00	7.75	48.4
3.........	312.00	155.00	157.00	144.00	11.00	54.	272.25	145.00	127.25	136.00	9.00	51.0	254.00	126.00	128.00	116.00	10.00	43.5
4........	242.00	117.50	124.50	111.50	6.00	41.8	225.00	116.50	108.50	101.00	15.50	37.9	224.50	115.00	109.50	95.50	19.50	35.8
	PLAT D.						PLAT E.						PLAT F.					
0.........	438.75	201.25	237.50	195.75	5.50	73.8	378.75	191.50	187.25	180.00	11.50	67.5	387.25	193.75	193.50	182.75	11.00	68.5
1.........	363.75	199.00	164.75	189.00	10.00	70.9	359.00	198.50	160.50	187.00	11,50	70.1	360.50	183.50	177.00	174.50	9.00	65.4
2.........	359.50	188.25	171.25	183.00	5.25	68.6	353.00	170.00	183.00	163.50	6.50	61.3	339.75	176.75	163.00	171.25	5.50	64.2
3........	288.00	149.50	138.50	144.00	5.50	54.0	276.50	139.50	137.00	132.50	7.00	49.7	281.75	147.00	134.75	138.50	8.50	51.9
4.........	287.00	148.25	138.75	138.25	10.00	51.8	257.00	125.00	132.00	112.00	13.00	42.0	291.50	157.00	134.50	148.50	8.50	44.7
	PLAT G.						PLAT H.						PLAT I.					
0.........	392.25	194.50	197.75	187.50	7.00	70.3	387.75	189.75	198.00	180.00	9.75	67.5	355.25	178.00	177.25	165.50	12.50	62.1
1.........	322.00	182.00	140.00	172.25	9.75	64.6	332.50	188.25	144.25	177.75	10.50	66.7	267.00	158.75	108.25	145.75	13.00	54.7
....	337.75	166.25	171.50	161.25	5.00	60.5	339.00	178.50	160.50	173.00	5.50	64.9	221.00	111.50	109.50	103.50	8.00	38.8

3	263.00	141.50	121.50	133.50	8.00	50.1	288.75	151.25	137.50	142.75	8.50	53.5	214.00	111.50	102.50	97.50	14.00	36.6
4........	336.00	163.00	173.00	151.50	11.50	56.8	324.00	163.00	161.00	151.50	11.50	56.8	235.50	113.00	122.50	95.00	18.00	35.6
	PLAT J.						PLAT K.						PLAT L.					
0........	366.50	186.00	180.50	174.50	11.50	65.4	371.00	180.00	191.00	164.50	15.50	61.7	330.50	169.50	161.00	160.00	9.50	60.0
1........	330.50	184.25	146.25	175.00	9.25	65.6	350.75	168.50	182.25	155.50	13.00	58.3	268.75	163.25	104.50	150.75	12.50	56.5
2........	352.50	186.75	165.75	173.50	13.25	65.1	364.00	177.50	186.50	172.00	5.50	64.5	325.25	171.25	154.00	165.50	5.75	62.1
3........	274.50	144.75	129.75	136.00	8.75	51.0	287.50	146.00	141.50	135.50	10.50	50.8	273.00	138.00	135.00	129.50	8.50	48.6
4........	343.00	173.75	169.25	164.50	9.25	61.7	346.50	182.25	164.25	171.75	10.50	64.4	392.00	190.75	201.25	181.50	9.25	68.1
	PLAT M.						PLAT N.						PLAT O.					
0........	332.50	166.00	166.50	157.50	8.50	59.1	235.75	143.50	92.25	136.50	7.00	51.2	336.37	174.00	162.37	166.50	7.50	62.4
1........	305.75	155.25	150.50	141.50	13.75	53.1	273.75	137.50	136.25	124.50	13.00	46.7	241.25	143.50	97.75	129.50	14.00	48.6
2........	355.00	173.50	181.50	170.00	3.50	63.8	377.75	167.00	150.75	153.50	13.50	57.6	325.75	165.00	160.75	158.50	6.50	59.4
3........	312.00	157.75	154.25	149.50	8.25	56.1	293.00	155.00	138.00	145.75	9.25	54.7	301.50	157.50	144.00	148.00	9.50	55.5
4........	338.50	166.75	171.75	158.00	8.75	59.3	314.75	155.75	159.00	143.25	11.50	53.7	347.50	171.00	176.50	159.75	11.25	59.9

The range of yield from the five sections of each plat is as follows, expressed in per cent of difference of sound corn: Between 49.9 per cent and 97.1 per cent on the most variable plat, B; and 16.7 per cent and 20.1 per cent on the least variable plat, M, according as the difference is computed on the highest or lowest yield as a basis.

With so even a stand of crop, and so little difference as has been shown in yield, both from the above test of fertilizers and in cultivation tests on the same field, one is safe in the assertion that these wide apart results are very largely due to variations in the fertility of the various sections of the plats and the relative capacity of those areas to produce a crop.

FERTILIZER EXPERIMENT WITH CORN.

An experiment with fertilizers for corn has been planned to continue several years on the same plats. The object is to compare the effects of different elements and combinations for corn when applied year after year on the same soil. In preparing the ground for this experiment, in order to overcome the force of differences in the previous fertilizing and cropping, as well as to start the experiment with a well-fed crop, a liberal dressing of barnyard manure was spread over all the plats to be used.

This dressing was well harrowed in and the ground fitted for the crop, working all plats alike, except where muck and barnyard manure is to be annually applied on C 17, D 19, E 19 and F 20, an extra amount of cultivation was needed to cover this extra application for this season.

The corn was planted May 23, and fertilizers sown the same day, save that on E 18, which was sown next day. The kind and amount of fertilizers applied are given in the following table, with the stand of corn just before harvesting. There were five or six kernels of seed dropped per hill, and when well started it was thinned to four stalks. The corn was cultivated and hand-hoed twice, and quite late in the season cleaned of weeds again by hand.

Special Fertilizers and Stand of Corn.

Plat.	REMARKS.	Sodium Nitrate.	Am'nium Sulphate.	Potassium Sulphate.	Dis'v'd Bone Black.	Barnyard Manure.	Plaster (gypsum).	Muck.	Soluble Pac. Guano.	High Grade Farmer's Friend.	Potassium Chloride.	Dissolved South Carolina Rock.	Ground South Carolina Rock.	Potassium Nitrate.	Number of hills.	Number of stalks.
		lbs.	lbs.	lbs.	lbs.		lbs.		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
C 14	....	480	..	..	..	..	..	..	..	....	..	....	....	..	199	768
C 15	....	..	..	400	..	..	..	..	..	....	..	....	....	..	200	757
C 16	....	..	..	..	400	..	..	..	..	....	..	....	....	..	200	770
C 17	....	..	..	..	..	*	..	..	..	....	..	....	....	.	200	755
C 18	No manure.	..	..	..	..	..	..	..	..	....	..	....	....	..	200	756
D 15	....	480	..	400	..	..	..	..	..	....	..	....	....	..	200	722
D 16	....	480	..	..	400	..	..	..	..	....	..	....	....	..	199	733
D 17	....	..	..	400	400	..	..	..	..	....	..	....	....	..	200	751
D 18	No manure.	..	..	..	..	..	..	..	..	....	..	....	....	..	200	742
D 19	....	..	..	..	..	†	..	..	..	....	..	....	....	..	200	766
E 15	....	480	..	400	400	..	..	..	..	....	..	....	....	..	200	750
E 16	....	240	..	200	200	..	..	..	..	....	..	....	....	..	199	754
E 17	No manure.	..	..	..	..	..	..	..	..	....	..	....	....	..	200	765
E 18	....	..	..	..	..	..	..	..	500	....	..	....	....	..	200	754
E 19	....	..	..	..	..	‡	..	..	..	....	..	....	....	..	200	784
F 17	....	..	..	..	..	..	600	..	..	....	..	....	....	..	200	784
F 18	No manure.	..	..	..	..	..	..	..	..	....	..	....	....	..	199	719
F 19§	....	..	..	..	..	..	..	..	..	....	..	....	....	..	200	752
F 20	....	..	..	..	..	..	..	‖	..	....	..	....	....	..	200	751
F 21	....	..	..	..	..	..	..	..	..	300	..	....	....	..	200	740
G 18	....	..	400	..	..	..	..	..	..	....	..	....	....	..	200	729
G 19	....	..	..	..	..	..	..	..	..	....	400	....	....	..	200	714
G 20	....	..	..	..	..	..	..	..	..	...	..	....	400	..	200	740
G 21	....	..	..	..	..	..	..	..	..	....	..	....	....	400	200	716
G 22	....	..	..	..	..	..	..	..	..	....	..	400	....	..	200	711

The corn was cut September 20, before one or two plats were fairly ready, indications of frost having hastened the harvest.

Before sufficiently cured to store in bin dull weather set in, with frequent light rains, and the corn could not be husked until

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* Ten two-horse loads. † Twenty two-horse loads. ‡ Thirty two-horse loads.

§ No manure this season. Winter rye to plow under for green manure.

‖ Twenty two-horse loads.

October 17 and 18. The proportion of stalks to corn is probably much higher than would have been the case with more propitious weather for the field curing, and it is also probable that there is more water in the harvested crop than will be found for a warmer season.*

Below are the harvest weights:

	Total crop, lbs.	Merchantable corn, lbs.	Unmerchantable corn, lbs.	Pounds stalks for 100 pounds merchantable corn.
Plat C 14	562	246½	11½	123
Plat C 15	410	170	13¾	133
Plat C 16	472	196	27½	127
Plat C 17	392	146	23	153
Plat C 18	454	208½	14½	111
Plat D 15	466	187¾	27½	134
Plat D 16	534	228½	31¼	120
Plat D 17	438	196	18½	119
Plat D 18	456	198	23½	118
Plat D 19	524	219	25	128
Plat E 15	534	206	26¾	146
Plat E 16	538	223	20¾	132
Plat E 17	528	248	12¼	108
Plat E 18	502	215	24	152
Plat E 19	474	198¼	28¼	124
Plat F 17	554	252¼	17½	113
Plat F 18	448	181¾	38¼	125
Plat F 19	512	225¼	34	112
Plat F 20	548	246½	25	112
Plat F 21	558	231½	34	126
Plat G 18	504	185¼	51¾	144
Plat G 19	396	91	88¾	238
Plat G 20	564	227	41¼	130
Plat G 21	550	228	39	120
Plat G 22	438	193½	24	114
Average	494.24	206	28.9	129.3

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* Station Report, 1886, page 39.

Notes were made on the relative appearance at various stages of growth, from which it appears that as far as they go for this season, the special nitrogenous fertilizers gave a very dark green color to the foliage, caused the plants to grow stocky and lengthened the period of growth, or in other words delayed ripening. The stover for these plats was greener and undoubtedly better at harvest than on any of the others. The plats which received three fertilizing elements appeared to be behind others early in the season, but gained relatively in the latter part of the season.

The plats which received no extra fertilizer, as well as those to which phosphoric acid was applied and the effect not obscured by other elements, ripened earliest, as indicated by the whitening of the husks and drooping ears. This corn was also in rather better condition for crib, while the ratio of stalks to merchantable corn was less than on most other plats. The application of potash had no appreciable effect on the ripening of the crop, or on the yield, unless it may have been in the case of potassium chloride to delay ripening and diminish the crop.

Corn on the plats to which muck and gypsum were applied was equal to that on any of the heavily-manured plats throughout the whole season, and these plats were among the most prolific at harvest. It is improbable that on an impoverished soil and under like conditions, gypsum or muck would have an equal effect with complete fertilization. The plat to which gypsum was applied, F 17, has yielded larger crops for three years than either of its duplicates, F 18 and 19. F 20, to which muck was applied, was heavily dressed in 1884, but gave no evidence in crop of additional fertility as a result, until this application of muck with manure may have had its effect in bringing dormant elements into an available condition.

With an abundant supply of the fertilizing elements in the soil muck and gypsum are undoubtedly of assistance, chemically or mechanically, in bringing plant food into a soluble condition for absorption, and on the other hand so ameliorating the condition of the soil that the root surface can be greatly enlarged and hence absorb more of the available nourishment than would be possible in the more restricted feeding ground of a denser soil.

Of course the previous treatment of these plats has had a great influence on the crop just produced from them, notwithstanding the manuring at the beginning of the experiment. This influence will gradually wear away with that of the manure with which all were treated alike, and then the effect of the continued application of different fertilizing elements should begin to tell in more marked differences than appear in this crop.

Below are the fertilizers applied and crops produced on these plats for the time they have been under experiment. For some years previous to the dates given all the plats were turfed :

FERTILIZERS APPLIED AND CROPS PRODUCED IN PREVIOUS YEARS.

PLAT C 14.

YEAR.	Fertilizer per acre.	CROP.	
		Kind.	Amount.
	Lbs.		Lbs.
1882....	400	Corn and pota's	190½
1883....	800	Potatoes........	767¼
1884....	400	Corn	232
1885....	1,000	Sorghum	2,741
1886....	400	Potatoes........	430½
1887....	00	Corn	206 5-16
Total,	3,000		

PLAT C 15.

YEAR.	Fertilizer per acre.	CROP.	
		Kind.	Amount.
	Lbs.		Lbs.
1882...	00	Amber cane	....
1883...	800	Potatoes........	756
1884...	400	Corn	192¾
1885...	1,000	Sorghum	2,520
1886...	400	Potatoes........	343
1887...	00	Corn	187¾
Total,	2,600		

PLAT C 16.

YEAR.	Fertilizer per acre.	Kind.	Amount.
1882....	800	Amber cane	....
1883....	800	Potatoes........	603¾
1884....	400	Corn	178¾
1885....	1,000	Sorghum	....
1886....	400	Corn	....
1887....	400	Corn	183⅞
Total,	3,400		

PLAT C 17.

YEAR.	Fertilizer per acre.	Kind.	Amount.
1882...	1,000	Amber cane	....
1883...	800	Potatoes........	658½
1884...	400	Corn and pota's	256
1885...	1,000	Sorghum	....
1887...	00	Corn	183¾
Total,	2,300		

PLAT C 18.

YEAR.	Fertilizer per acre.	Kind.	Amount.
1883....	00	Flax.............	39½
1884....	400	Corn and pota's	....
1885....	1,000	Sorghum	....
1886....	*400	Squash	....
1887....	00	Corn	199 9-16
Total,	1,800		

PLAT D 15.

YEAR.	Fertilizer per acre.	Kind.	Amount.
1882...	00	Amber cane	....
1883...	400	Amber cane	....
1884...	00	Potatoes........	883
1885...	400	Corn	275
1886...	1,600	Corn	1,255½
Total,	2,400		

PLAT D 16.

YEAR.	Fertilizer per acre.	Kind.	Amount.
1882....	200	Amber cane	....
1883....	400	Amber cane	....
1884....	400	Potatoes........	632
1885....	400	Potatoes........	314
1886....	200	Corn	1.489½
Total,	1,600		

PLAT D 17.

YEAR.	Fertilizer per acre.	Kind.	Amount.
1882...	400	Amber cane	....
1883...	400	Corn	1,761
1884...	400	Potatoes........	392
1885...	400	Potatoes........	310½
1886...	200	Corn	1,556½
Total,	1,800		

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* And ten cords stable manure.

FERTILIZERS APPLIED AND CROPS PRODUCED — (*Continued*).

PLAT D 18.

YEAR.	Fertilizer per acre.	CROP. Kind.	CROP. Amount.
	Lbs.		Lbs.
1882	600	Amber cane	....
1883	400	Amber cane	1,131
1884	400	Potatoes	570
1885	400	Potatoes	411
1886	00	Corn	1,036
Total,	1,800		

PLAT E 15.

1883	400	Amber cane	....
1884	400	Potatoes	853
1885	400	Corn	254¾
1886	200	Corn	247¼
1887	00	Corn	198 1-16
Total,	1,400		

PLAT E 17.

1883	400	Amber cane	1,133
1884	400	Potatoes	332
1885	400	Oats,	87½
1886	400	Corn	232 7-16
1887	......	Corn	207
Total,	1,600		

PLAT E 19.

1883	400	Amber cane	....
1884	400	Potatoes	349
1885	400	Oats	79½
1886	800	Corn	214 5-16
1887	......	Corn	170⅝
Total,	2,000		

PLAT F 18.

1885	400	Wheat	7½
1886	400	Corn	147½
1887	......	Potatoes	346
Total,	800		

PLAT D 19.

YEAR.	Fertilizer per acre.	CROP. Kind.	CROP. Amount.
	Lbs.		Lbs.
1883	400	Amber cane	....
1884	400	Potatoes	414
1885	400	Potatoes	201¼
1886	400	Corn	1,437½
Total,	1,600		

PLAT E 16.

1883	400	Amber cane	....
1884	400	Potatoes	823
1885	400	Oats	132
1886	200	Corn	199 7-16
1887	00	Corn	194⅜
Total,	1,400		

PLAT E 18.

1883	400	Corn	1,489
1884	400	Potatoes	575
1885	400	Oats	131½
1886	......	Corn	215¼
1887	......	Corn	178 1-16
Total,	1,200		

PLAT F 17.

1885	400	Wheat	87¼
1886	400	Corn	203⅝
1887	......	Potatoes	482¾
Total,	800		

PLAT F 19.

1885	400	Wheat	86½
1886	400	Corn	120¾
1887	......	Potatoes	421¼
Total,	800		

FERTILIZERS APPLIED AND CROPS PRODUCED — (*Continued*).

YEAR.	PLAT F 20.			YEAR.	PLAT F 21.		
	Fertilizer per acre.	CROP.			Fertilizer, per acre.	CROP.	
		Kind.	Amount.			Kind.	Amount.
	Lbs.		Lbs.		Lbs.		Lbs,
1884....	1,000	Corn	193	1884...	400	Beans	....
1885....	......	Pumpkin	....	1885...	......	Squashes	....
1886....	400	Corn	156 3-16	1886...	400	Corn	166 11-16
1887....	......	Potatoes	306¼	1887...	......	White potatoes	328¼
Total,	1,400			Total,	800		
		PLAT G 18.				PLAT G 19.	
1885....	......	Tobacco	....	1885...	480	Tobacco	....
1886....	400	Tomatoes	....	1886...	400	Tomatoes	....
1887....	......	....	....	1887...	......	....	....
Total,	400			Total,	880		
		PLAT G 20.				PLAT G 21.	
1885....	680	Tobacco	....	1885...	......	Corn	....
1886....	400	Tomatoes	....	1886...	400	Tomatoes	....
1887....	......	Corn	....	1887...	......	Corn	....
Total,	1,080			Total,	400		

PLAT G 22.

YEAR.	Fertilizer, per acre,	CROP.	
		Kind.	Amount.
	Lbs.		
1885	....	Corn	....
1886	400	Tomatoes	....
1887	....	Corn	....
Total	400		

No conclusion reached, since this is simply the beginning of the experiment. The apparent comparative effect of fertilizers for this season discussed. Potash gave no positively noticeable effect.

Phosphoric acid hastened maturity.

Nitrogen delayed ripening and lengthened the growing season.

WATER SUPPLY.

The Station water supply is derived from a stratum of gravel and sand in a wooded hillside about one and one-half miles northwest from the Station. Up to this year the water has been collected in a small reservoir 6x6x4 feet. When full there would be about 350 gallons of water above the draught pipe.

The water was collected by a main catch-water drain 1,700 feet long from a spring, and by numerous branches from the hillside above.

This drain has supplied considerable water when active for its entire length, but owing to its open character has of course lost much of the water and cost a great deal in the way of reopening for repairs since its establishment under private ownership.

Once or twice before, since the organization of the station, this ditch has been more or less thoroughly repaired and there has been at still other times, and in fact, nearly always during a dry time too little water to do more than run one thing at a time, *i. e.*, when water was being used for the green-house, the dairy and laboratory were necessarily cut off and *vice versa.*

The past summer the whole main ditch was opened. Some of the main line and many of the laterals were found filled with roots; the supply of water seemed abundant, if storage enough could be afforded to draw upon for a full day's supply, or in case of an emergency.

The old tiles as a main were abandoned and wrought iron pipes laid in their stead, with tile laid wherever there seemed to be a chance to bring in an additional supply of water. Iron laterals were laid to small, deeply inclosed basins, which were often the termini of one to three lines of tiles that were laid to follow back some source of water and conduct it to the iron lateral.

By this means as much water was collected during the dryest part of the season as could be discharged through a $1\frac{1}{4}$ inch pipe with a fall of 7 feet in 700 feet of pipe. Some water is also received from pipes not connected with the long main.

The total amount of pipe laid was 700 feet of $1\frac{1}{4}$ inch, and 1,500 feet of 1 inch.

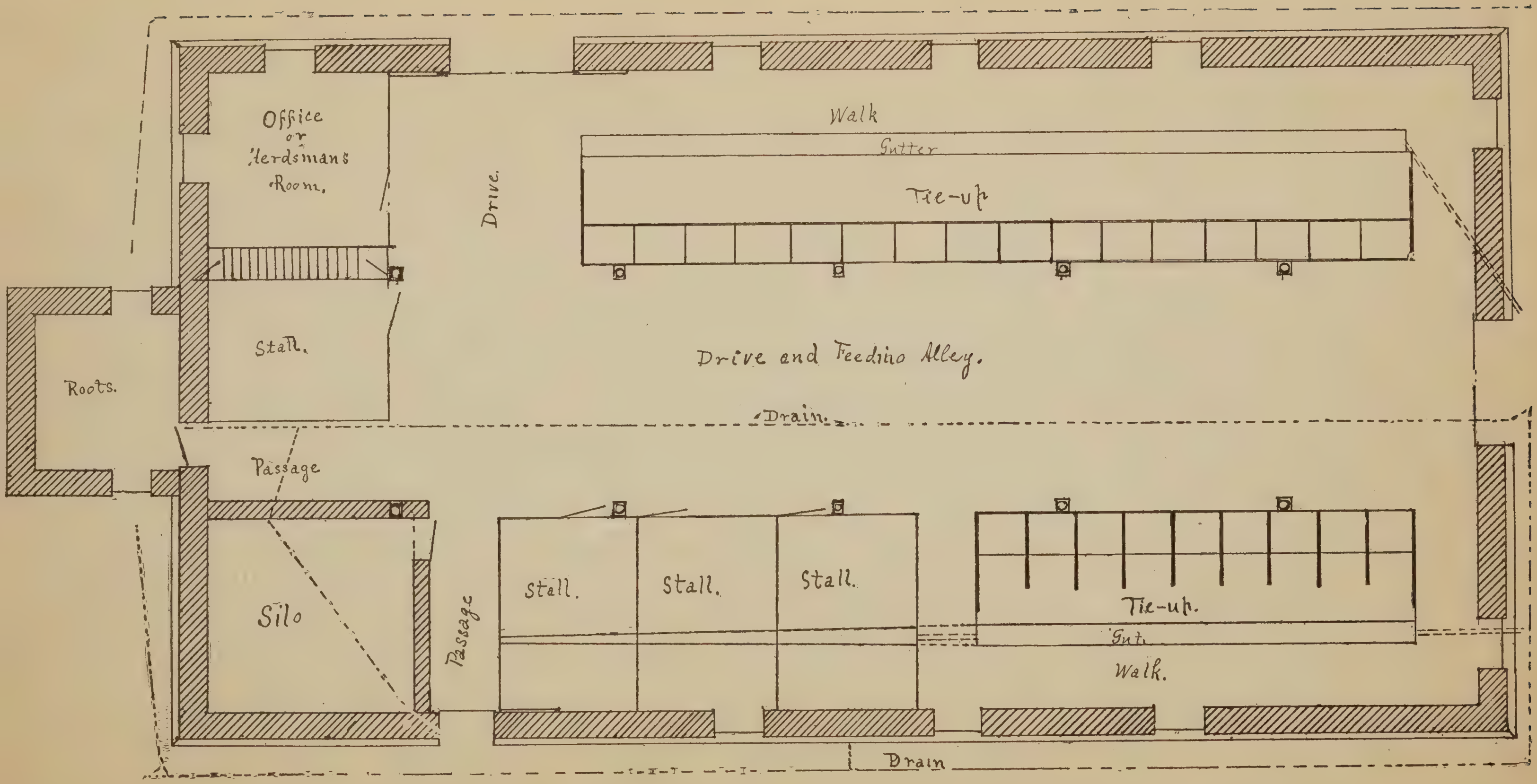

Diagram of Basement.

There has been a good supply for all ordinary purposes since and no necessity for taking turns in using water. Recently, there has been added a wooden reservoir 11½x22½ feet in lateral dimensions and 6 feet deep. This will never stand quite full, but for every foot above the draught pipe will add 1,935 gallons of water on which to draw in case of necessity.

THE NEW BARN.

Stands nearly north and south and presents a broadside view to the street, as the station is approached from the village. It has a lantern roof surmounted by two cupolas, each 10 feet square, which set equally distant from the ends over the middle of the second bents.

Ground was broken for this barn August 9. It sets south of the old one and parallel with the south portion. The west side of the new barn is in the same straight line with the east side of the old, and there is a space of 50 feet between the nearest corners.

The basement wall of the new barn is 97x51 feet outside measure at the level of the door sills. There is a "batter" on the outside of 6 inches from the door sills to the top of the wall. This gives the size of the barn which just covers the wall, 96x50 feet. The basement within the walls is 92x46 feet, and 9 feet high above the door sills, which give the level for the highest point of the main floor.

The basement is lighted by 10 windows of twelve 10x14 lights, and eight panes of 10x12 glass in a transom over each of the two pairs of double sliding doors which allow admission to a team on the east side 20 feet south of the northeast corner, and in the middle of the south end. Passing in at the east door, one enters a feeding floor 16 feet wide which can be used to bring green food direct from the cart to the animals, and to remove the excrement and litter.

On the east side and south of the doorway is a "tie-up" 60 feet long with a 4½ feet walk behind the animals and around the south end. Opposite this "tie-up" is another 31½ feet long, with a wall of the same width around it, and three box stalls 10x14 feet.

The silo is in the northwest corner. It is 14x15x30 feet, extending from 2½ feet below the basement floor to the second floor above. Between the silo and box stalls, a passage 4½ feet wide and a four-foot door makes the way from the cow stable to the dairy nearly a straight line. In the northeast corner a room is intended to be used as a barn office or herdsman's room.

The stairway leading to the main floor is between this room and another, designed for a lying-in stall, or storage for feed or bedding. A passage between the latter and the silo leads to a room under the driveway 10x11 feet which will hold 700 bushels of roots. The floor of this room is on a level with the silo bottom. The floor of the basement is all of cobblestone and cement, except the platforms and gutters which are of elm plank laid in fresh cement. Very little of the floor is level. The feeding floor slopes gently to three central points which are connected with a drain. The small room under the driveway is also connected with the same drain and a branch of it reaches under the silo floor but has no connection with the silo.

The "tie-ups" with the walks around same, and the box-stalls on the west side all slope to the gutters which are to empty through glazed tile with cemented joints into a cistern 3 or 4 rods south of the barn. This cistern will be at one extremity of the manure yard which will be so graded, that whatever drainage there may be from the manure pile will return to the cistern, the contents of which will be kept pumped over the manure pile. This liquid will be supplemented, when necessary to prevent burning, by water from the barn supply pipe which extends through the south wall of the basement for that purpose. Returning to the basement we pass up the stairs indicated above, and find ourselves at the left of the main entrance at the north end. There are 6 bents of 16 feet each lengthwise the barn, and the 50 feet width is apportioned into two outside bents of 17 feet each, and the middle one of 16 feet. The silo occupies the whole of the northwest bent and a grain room behind the stairway fills the northeast bent. The remainder of the main floor is open, except for the interior posts at intervals of 16 feet, which support the upper floor and roof. This main room less the north bent is 80x50 feet and is 15 feet high. It will be used for storing such experimental field crops as may be found desirable to keep by themselves longer than to take harvest weights; to store hay; and to work the horse power, and feed and silage cutters, threshing and winnowing machines.

Above the stairway from the basement a series of short flights of stairs rise alternately to the north and south and furnish easy communication between the basement and storage loft, and also easy access to the upper windows used to ventilate the main barn, to the hay carrier track and the cupolas were part of the meteorological instruments will be located. Hay is drawn up and thrown down through an opening in the second floor 11x15 feet in the middle of each of the middle bents.

This is briefly the plan of the barn. It was planned and has been built with three leadings points in view:

First, the storage of plat crops separate from each other. The desirability of such a plan has been freshly demonstrated the past season with fertilizer experiments on grass and oats. A few samples were taken for analysis by the chemist in the prosecution of his regular studies on the composition of crops. On analysis his attention was attracted by an interesting point which it was desirable to follow up, but which had been lost by mixing the plat with the common field crops.

Another point is that when a crop is ready for harvest there is often more time required for detailed examination than weather conditions will allow, and if ample storage can be provided into which such crops can be placed they can be examined in detail with no danger of loss, and unmolested by climatic conditions.

The second and central point was the accommodation of dairy stock. It has been proposed to give a fair and impartial trial to representative breeds of dairy cattle throughout in every controllable respect. It is evident to all that such an experiment must be provided with ample stabling accommodations that one set of animals may not be at disadvantage from colder stabling or other unpleasant drawbacks resulting from poor stable accommodations. This barn basement is well lighted, watered, and promises to be so comfortable a home for dairy animals that there can be no question arise as to its fitness for the object in view.

The broad feeding floor was specially designed to provide room for experimental feeding with a larger number of animals than we have accommodation for elsewhere. Where all the food is weighed and every animal has its ration separate from its fellows more room is required than in ordinary feeding, especially where the scales must be used for every item.

Water is brought to the floor and can be drawn into a pail and weighed, or the animals can be watered by lifting the cover in its manger for that section of the continuous water box for that line of stanchions. Incidentally, too, there will be the object lesson open to all our visitors and readers in regard to the disposal and care of manure. This has been detailed above and need not be repeated here.

Third, to provide a suitable place for some of our meteorological instruments.

Up to the present time the sunshine recorder has been from place to place with the result of breaking the record as may be seen in this report. The anemometer can only be attended to by an observer daily invading that portion of the station building set apart for the private use of the Director's family.

Hence the adaptation of the barn to this use by providing stairways and inclosing a room in the north cupola which can become the meteorological room of the station.

The construction of the silo is detailed below. It has been found that silos may not only be filled and their contents properly cured without weighting, but that wooden walls are better than stone for preserving silage.

In the construction of this silo the stone walls of the basement were used so far as they went, then wood was used for the remainder. This use of the two kinds of material will give the station a chance for an annual trial of both kinds, under the same conditions.

CONSTRUCTION OF SILO.

The stone wall is 2½ feet high on the interior sides and 11½ feet high on the exterior sides. The bottom consists of 6 inches of stones, through which a line of tile connects with a ditch, and 3 inches of cement made up with two parts cement to three of gravel. The stone sides are plastered up smooth from the floor to the wooden wall. The upright timbers of the silo are 28 feet long by 5x10 inches, set edgewise to the silo, 3 feet 8 inches apart with

2x10 set between. The outsides above main wall have only 2x10 supported by the exterior walls of the barn. The inside is boarded horizontally with matched hemlock, sheathed with tarred building paper, and boarded again with matched pine. The bottom of the timbers are backed by the nine inches of stones and cement of the basement floor, and they are strongly supported in the middle by the main floor and by the second floor at the top. The outside is covered with a good quality of hemlock flooring.

In the basement there is a door 3x7 feet through which to remove silage when low enough, while a trap through the main floor, and two doors above in a vertical line allows the most economical filling and emptying.

METEOROLOGY FOR 1888.

The past season has seemed a comparatively cold one to those who are accustomed to this locality. There has been a great deal of wind, often rising in the morning and going down at evening. This, if not a normal characteristic of the neighborhood, may, from its drying and cooling effect, account in part for the impression that the season has been colder than usual.

The monthly extremes of temperature together with the monthly means of the three previous years have been as follows:

EXTREMES AND RANGE OF TEMPERATURE FOR 1888, WITH MONTHLY MEANS FOR FOUR YEARS.

	Maximum.	Minimum.	Mean of maximum.	Mean of minimum.	Greatest range.	Mean monthly temperature.	Mean monthly temperature.	Mean monthly temperature.	Mean monthly temperature.
1888.						1888.	1887.	1886.	1885.
January	43.2	—6.°	24.3	8.4	49.2	17.80	21.60	20.58	21.05
February	49.	—7.°	31.1	14.5	56.	24.38	25.42	23.22	14.23
March	57.	0.0°	32.7	16.5	57.	25.98	27.65	32.37	21.15
April	82.5	19.0	48.5	30.5	63.5	43.28	43.85	50.40	43.78
May	79.8	29.0	63.4	45.1	50.8	56.40	65.80	58.45	58.03
June	94.1	40.0	74.8	55.6	54.1	70.45	69.22	67.95	66.93
July	89.8	49.0	78.1	55.4	40.8	71.16	78.00	71.47	72.91
August	92.6	48.3	78.2	57.9	44.3	70.48	68.92	69.70	65.98
September	83.0	33.5	69.6	48.6	49.5	59.84	59.55	63.60	60.65
October	62.7	29.0	51.1	37.3	33.7	44.37	46.11	51.07	49.04
November	73.0	8.0	47.4	31.4	65.0	39.28	37.30	37.17	39.90
December	......	......	......	......	......	......	28.35	22.85	28.89
Mean yearly temperature	......	......	......	......	......	......	47.65	47.40	45.21

Inspecting the table of mean monthly temperatures one finds four months to have been warmer than the mean of the corresponding months of the three years 1885–6 and 7, while seven have been colder. Adding the differences of temperature between the months of 1888 which were found warmer than the mean, and also those where these months were colder, and subtracting, gives 12.2° F.

lower temperature for the eleven months of 1888 than for the mean of the corresponding months compared.

The greatest depression from the mean was, in the order named: October, May and January respectively, 4.37° F., 4.36° F. and 3.54° F.

The greatest elevation above the mean was, in the same order: February, June and August respectively, 3.54° F., 2.42° F. and 2.28° F.

That part of the table devoted to maximum and minimum temperature means and range is interesting as showing something of the vicissitudes of temperature to which our crops must be subjected. These figures do not tell the whole story, either, for these extremes are very apt to occur with only a comparatively short interval between them, and then, too often, when vegetation is struggling with an inadequate water supply. The periods of summer drought are usually those of greatest and most rapid range of temperature during the growing season.

The number of days in each month on which there was an appreciable amount of precipitation is recorded and compared with similar data for previous years in the following table:

DAYS ON WHICH PRECIPITATION WAS APPRECIABLE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1882........	......	......	......	......	......	9	12	10	6	7	7	4	55
1883........	13	13	12	11	16	12	13	9	10	10	5	11	135
1884........	11	14	16	11	15	10	12	6	7	13	8	10	137
1885........	12	7	8	13	13	12	9	20	6	12	15	12	139
1886........	12	11	11	10	7	7	12	6	11	9	11	13	120
1887........	12	15	10	9	7	9	10	7	5	15	9	9	117
1888........	14	6	9	9	16	13	7	11	9	19	12	......	......
Average of previous years	12	12	11.4	10.8	11.6	9.8	11.3	9.7	7.6	11	9.1		
1888 + or −	+2	−6	−2	−2	+4	+3	−4	+1	+1	+7	+3		

PRECIPITATION BY MONTHS SINCE 1882.

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
1882	....	....	....	....	....	3.69	2.42	2.37	1.25	0.62	1.22	0.55	.....
1883	0.48	1.44	0.88	1.58	4.45	4.12	2.98	3.47	2.12	2.10	1.54	0.73	25.89
1884	1.83	2.01	2.54	0.83	2.49	2.01	2.33	1.44	3.17	1.67	1.01	0.97	22.30
1885	1.07	0.61	0.12	1.26	1.58	2.49	4.64	5.02	2.11	2.88	1.36	0.76	23.90
1886	1.13	0.95	1.13	4.13	1.92	2.92	4.41	2.86	2.31	1.39	3.48	1.24	27.87
1887	0.18	2.97	0.48	1.37	0.46	2.01	6.37	3.03	0.75	1.74	1.58	1.35	22.29
1888	0.78	1.04	1.43	3.09	2.79	3.88	0.99+	4.02	2.73	3.47	2.02	....	.....

From the above table we deduce the mean monthly rainfall since and including June, 1882. Below is a comparison of this mean monthly rainfall with the rainfall of 1888:

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Mean monthly rainfall	0.95	1.596	1.03	1.834	2.18	2.873	3.86	3.03	1.95	1.73	1.698	0.93
Rainfall, 1888	0.78	1.04	1.43	3.09	2.79	3.88	0.99	4.02	2.73	3.47	2.02	....
For 1888, + or — mean	—.17	—.556	+.40	+1.156	+.61	+1.007	—2.87	+.99	+.78	+1.74	+.322	....

Excess over mean in eleven months, 3.409 inches.

This record of rainfall for the winter months is hardly to be relied on, since much of the precipitation is snow, which frequently blows over and out of the gauge, so there may often be a considerable fall with not enough lodged in the gauge to be appreciable when melted and measured.

This objection, however, does not affect the summer months, which most concern our farm crops and animals.

During these months, from April to October inclusive, the rainfall for 1888 has exceeded the average for the six preceding years of every month, except the droughty one of July, when the fall was only .99 inch, which is 2.87 inches below the average.

This comparison brings out the fact that for six months the rainfall was in all 6.383 inches more than the average, and that the deficiency for July reduced the excess to 3.513 inches for the season. Thus we may say the past season has been (except the drouth of July) a rainy, or wet one, as well as a cool one, for we have seen that the lower temperature was in harmony with the popular belief, while the sunshine record was 2.5 per cent lower than the average of the four midsummer months for three previous years.

WIND.

The direction of wind has been recorded by an anemometer put in successful operation by a former observer who * had some difficulty in clearly interpreting the record owing to the running together of the lines and consequent wearing away of the paper. This difficulty was overcome by increasing the distance and speed of movement by clockwork past the recording pen, and decreasing distance traversed by the pen itself, as it with the vane to which it is attached obeys every fluctuation and change of the wind.

The record of direction is accurate and continuous.

An attempt to record the force in pounds has not yet been a success. The record of prevailing wind obtained during the summer is given below. For several days in June, and more than half of July no record was taken. At several other times there were breaks for short intervals. All the hours of positive record obtained are given in hours in the following table under the heading of the direction from which the movement proceeded. The differences between the hours of record and 24 were either calms or when the wind was too light to give movement to the vane and is left blank.

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* C. S. Plumb, Prof. of Ag., etc. Knoxville, Tenn.

PREVAILING WIND, APRIL TO OCTOBER INCLUSIVE, 1888.

APRIL.					MAY.					JUNE.					JULY.				
Date.	N. W. to N. E., hours.	N. E. to S. E., hours.	S. E. to S. W., hours.	S. W. to N. W., hours.	Date.	N. W. to N. E., hours.	N. E. to S. E., hours.	S. E. to S. W., hours.	S. W. to N. W., hours.	Date.	N. W. to N. E., hours.	N. E. to S. E., hours.	S. E. to S. W., hours.	S. W. to N. W., hours.	Date.	N. W. to N. E., hours.	N. E. to S. E., hours.	S. E. to S. W., hours.	S. W. to N. W., hours.
1	..	..	..	..	1	21	....	....	1	1	....	....	....	10	1	....	....	....	....
2	..	..	..	..	2	....	5	3	....	2	10	....	....	9	2	....	....	....	....
3	3	..	..	2	3	....	....	18	....	3	5	....	....	6	3	....	....	....	....
4	..	..	..	..	4	....	....	12	10	4	....	....	4	4	4	....	....	....	....
5	..	..	..	4	5	1	....	....	10	5	....	....	....	4	5	....	....	....	....
6	..	..	4	18	6	5	....	....	14	6	7	....	....	16	6	....	....	....	....
7	..	..	..	6	7	4	....	4	....	7	4	2	....	....	7	....	....	....	....
8	3	..	..	..	8	....	....	21	....	8	....	....	5	....	8	....	....	....	....
9	..	..	..	6	9	....	....	8	....	9	....	....	11	3	9	....	....	....	....
10	..	5	5	5	10	....	....	8	....	10	4	....	....	17	10	....	....	....	....
11	..	..	11	9	11	....	....	15	....	11	4	1	....	....	11	....	....	....	....
12	..	..	6	15	12	3	....	3	7	12	....	....	....	....	12	....	....	....	....
13	..	..	..	..	13	6	....	....	....	13	....	....	....	....	13	1	....	....	23
14	..	7	2	4	14	3	....	....	4	14	....	....	....	....	14	2	....	....	3
15	5	..	..	..	15	1	....	5	8	15	....	....	....	....	15	....	....	....	....
16	14	..	..	..	16	2	....	....	20	16	....	....	....	....	16	....	6	....	....
17	..	..	8	2	17	3	....	....	3	17	6	....	....	6	17	....	....	24	....
18	5	..	..	6	18	....	....	3	9	18	6	....	....	....	18	1	....	20	....
19	5	..	..	5	19	....	....	....	24	19	1	2	3	....	19	....	1	2	8
20	6	..	..	17	20	6	....	....	3	20	6	....	....	....	20	3	....	3	1
21	..	..	..	24	21	....	3	4	....	21	....	2	6	5	21	....	....	....	....
22	2	..	..	5	22	....	....	13	....	22	....	....	....	20	22	....	....	....	....
23	12	..	..	7	23	....	1	8	....	23	....	....	1	2	23	....	....	....	....
24	7	..	..	10	24	....	1	6	....	24	2	....	....	4	24	....	....	....	....
25	..	..	3	3	25	....	....	23	....	25	....	....	....	....	25	....	....	....	....
26	1	..	2	..	26	....	....	12	....	26	....	....	....	....	26	....	....	....	....
27	..	..	1	..	27	2	2	8	....	27	....	6	6	....	27	10	1	....	....
28	5	..	..	..	28	....	1	7	8	28	....	16	....	....	28	4	2	....	....
29	10	..	..	2	29	8	....	....	10	29	....	....	2	6	29	3	3	....	....
30	18	..	..	..	30	....	....	....	....	30	....	....	....	....	30	3	2	2	3
..	..	..	..	..	31	....	....	....	....	..	....	....	....	....	31	....	....	1	13
..	96	12	42	150	..	65	13	181	131	..		29	44	112	..	27	15	52	51
..	*32	*4	*14	*50	..	*16⅔	*3⅓	*46.4	*33.6	..	*22.9	*12.1	*18.3	*45.8	..	*11.7	*10.3	*35.9	*35.2

* Per cent.

PREVAILING WIND — (*Continued*).

AUGUST.					SEPTEMBER.					OCTOBER.				
Date.	N. W. to N. E., hours.	N. E. to S. E., hours.	S. E. to S. W., hours.	S. W. to N. W., hours.	Date.	N. W. to N. E., hours.	N. E. to S. E., hours.	S. E. to S. W., hours.	S. W. to N. W., hours.	Date.	N. W. to N. E., hours.	N. E. to S. E., hours.	S. E. to S. W., hours.	S. W. to N. W., hours.
1	......	......	......	2	1	....	....	....	14	1	....	....	15	.....
2	3	......	2	3	2	2	1	1	5	2	8	....	....	15
3	......	5	3	6	3	....	....	14	2	3	....	1	....	11
4	7	......	1	2	4	7	2	2	12	4	....	....	6	.....
5	......	......	......	......	5	7	2	....	....	5	1	....	....	1
6	......	......	......	......	6	4	1	4	....	6	....	7	....	14
7	......	......	......	......	7	....	5	19	....	7	....	....	....	.....
8	......	......	......	20	8	....	....	13	5	8	13	....	....	10
9	6	......	......	8	9	1	....	....	10	9	3	....	....	21
10	10	1	......	......	10	3	....	....	3	10	4	....	....	2
11	5	4	......	......	11	....	....	14	2	11	2	15	....	.....
12	7	......	......	7	12	....	....	....	23	12	....	3	2	2
13	7	......	......	7	13	1	....	....	18	13	15	3	....	.....
14	7	......	......	......	14	4	5	....	1	14	5	....	....	1
15	......	......	2	11	15	....	13	4	....	15	....	1	6	.....
16	2	......	2	8	16	2	2	2	....	16	....	....	13	5
17	......	......	......	9	17	2	6	....	7	17	....	....	....	24
18	......	1	1	2	18	6	....	3	3	18	....	....	9	5
19	1	......	......	12	19	....	....	13	8	19	....	....	....	.....
20	5	......	7	......	20	4	...	....	15	20	....	....	5	19
21	12	......	7	3	21	....	....	....	11	21	11	....	1	.....
22	......	1	......	23	22	5	....	....	15	22	....	2	11	.....
23	......	......	......	......	23	....	1	....	....	23	....	....	....	.....
24	......	......	3	21	24	2	3	2	3	24	....	....	1	3
25	......	......	4	14	25	5	....	7	....	25	....	5	1	.....
26	......	......	......	......	26	....	....	14	4	26	....	....	....	24
27	1	......	......	17	27	4	....	....	19	27	....	....	....	.....
28	3	......	6	8	28	6	....	....	11	28	3	....	....	21
29	......	1	6	7	29	4	....	...	5	29	....	....	1	23
30	.....	7	7	1	30	2	....	20	....	30	4	5	3	.....
31	7	......	1	5	....	....	....	....	....	31	....	....	....	2
....	83	20	52	196	....	71	41	132	196	....	69	42	84	202
....	*23.6	*5.7	*14.8	*55.8	....	*15.4	*9.3	*30.0	*44.5	......	17.4	*10.3	*21.2	*50.9

* Per cent.

FROSTS.

The latest frosts in spring and earliest in fall were on May 21st and September 6th, thus making the season between frosts on the Station farm 108 days. The frosts which occurred on the mornings of September 6th and 7th did little or no damage on the farm, as corn, sorghum and other crops were yet standing and escaped unharmed. These crops were too immature for harvest at that time, about the usual harvest season, owing undoubtedly to the general backwardness of the season, as well as to the dull and cloudy weather of the later part of the summer, and they were left standing for some time at the risk of being frost-bitten, in the hope that there might be a few sunny days which would go far toward maturing the crop.

SOME CASUAL PHENOMENA OBSERVED DURING THE SEASON HAVE BEEN AS FOLLOWS:

	Polar bands.	Auroras.	Solar halos.	Lunar halos.	Rainbows.	Mock suns.
January	......	....	....	....	....	21st-22d-24th
February	......	....	....	....	....	....
March	25th	18th	....	....	....	19th
April	......	3d, 11th	17th	....	....	25th
May	21st	....	....	....	....	....
June	......	....	....	....	....	....
July	......	....	....	....	....	....
August	20th	....	....	....	....	....
September	......	....	3d-7th	....	9th-12th, 16th	....
October	......	....	11th, 15th	15th-19th	....	....
November	......	....	....	14th	1st	....

March	18th.	Robins first seen.
March	27th.	Thunder shower of short duration.
April	9th.	White frost.
April	10th.	Red maple in bloom.
May	3d.	White frost.
May	4th.	Swallows appeared.
May	21st.	White frost.
September	6th.	White frost.

September 7th. White frost.
October 10th. Ground frozen ¼ inch.
October 11th. White frost.
October 15th. White frost.
October 22d. White frost; ground frozen.

SUNSHINE RECORD.

On June 4th, paper of suitable quality for records having been obtained, the Negretti & Zambra sunshine recorder was returned to the old position which it had occupied previous to September 8, 1887.

A full record of all sunshine was secured up to October 1st, when a Station observer was cut off from access to the place, and the record was again discontinued. Below is a comparison of sunshine record for 1888, with the corresponding periods of previous years.

COMPARISON OF DAILY SUNSHINE RECORDS, JUNE TO SEPTEMBER INCLUSIVE.

MONTH.	1885.	1886.	1887.	1888.	Possible sunshine.
June 1	12.15	12.30	4.00	......	15.05
2	11.00	2.45	.45	......	15.06
3	10.30	8.00	11.45	......	15.08
4	1.15	13.45	......	4.30	15.09
5	6.45	12.00	......	11.30	15.09
6	12.15	12.45	......	9.45	15.10
7	8.15	9.45	1.30	1.00	15.11
8	4.30	13.15	7.00	12.15	15.12
9	13.45	5.15	2.45	10.30	15.13
10	12.45	10.45	12.15	4.30	15.14
11	12.45	12.45	12.30	3.45	15.15
12	12.00	6.15	12.45	12.00	15.15
13	6.15	11.30	10.00	4.15	15.16
14	13.30	7.00	14.00	7.00	15.16
15	4.45	9.45	13.45	7.45	15.16
16	3.00	3.30	9.15	11.30	15.17
17	13.15	2.45	2.00	12.25	15.17
18	13.45	11.30	......	12.30	15.18
19	13.15	10.15	1.30	11.00	15.17
20	9.00	9.15	9.15	9.30	15.17
21	7.30	3.00	4.00	8.30	15.17
22	7.15	......	1.30	11.30	15.17
23	14.15	......	10.30	4.00	15.17
24	13.00	0.45	2.00	4.15	15.17
25	8.15	7.15	9.30	7.15	15.17
26	13.30	4.30	13.30	2.15	15.16
27	10.45	11.15	11.30	10.00	15.16
28	2.45	14.00	13.45	0.00	15.15
29	0.15	12.30	13.30	2.30	15.15
30	8.45	13.45	12.00	11.30	15.15
Total	281.00	252.15	217.45	207.42	457.03
Per cent of possible sunshine	61.5	54.2	47.6	45.7	......

COMPARISON OF DAILY SUNSHINE RECORDS — (*Continued*).

MONTH.	1885.	1886.	1887.	1888.	Possible sunshine.
July 1	14.00	13.15	11.00	8.00	15.13
2	2.45	6.15	12.30	13.15	15.12
3	4.45	12.30	10.15	12.35	15.12
4	4.15	12.45	11.15	11.30	15.11
5	10.00	13.00	4.45	8.30	15.10
6	12.15	9.15	8.00	12.25	15.09
7	5.00	5.45	12.45	12.00	15.8
8	12.30	14.00	13.00	5.15	15.7
9	10.00	3.15	4.15	.45	15.6
10	10.00	11.45	2.15	12.00	15.5
11	13.15	10.00	13.00	6.45	15.4
12	14.00	11.45	13.00	7.00	15.3
13	1.45	8.00	11.15	10.20	15.1
14	1.15	......	11.30	11.45	14.59
15	10.15	1.15	1.30	10.45	14.58
16	9.15	1.00	10.15	12.30	14.56
17	12.30	8.15	4.00	5.20	14.55
18	12.30	2.45	1.15	+	14.54
19	12.30	1.00	11.00	4.30	14.52
20	11.30	7.00	11.00	10.00	14.50
21	8.45	9.00	3.15	10.30	14.48
22	10.45	10.30	4.30	10.00	14.46
23	9.00	13.00	9.00	7.00	14.45
24	6.00	12.00	10.30	13.00	14.43
25	5.15	5.15	0.30	12.45	14.41
26	1.45	......	8.00	3.30	14.39
27	13.45	10.15	12.30	6.30	14.37
28	11.30	10.00	11.15	10.00	14.35
29	11.15	4.30	7.00	9.30	14.33
30	12.30	7.45	11.30	12.00	14.31
31	12.45	8.15	11.45	4.45	14.28
Total	289.30	243.15	267.30	270.67	462.11
Per cent of possible sunshine	62.6	52.6	57.9	58.9	....

COMPARISON OF DAILY SUNSHINE RECORDS — (*Continued*).

MONTH.	1885.	1886.	1887.	1888.	Possible sunshine.
August 1	10.45	6.15	10.45	12.30	**14.26**
2	7.15	11.00	11.15	7.30	**14.24**
3	0.0	8.16	11.35	7.15	**14.22**
4	8.00	9.45	6.10	3.45	**14.20**
5	4.00	3.45	2.45	2.45	**14.17**
6	12.00	12.30	8.30	8.00	**14.15**
7	2.30	4.45	12.45	12.00	**14.13**
8	7.00	12.15	12.30	8.15	**14.11**
9	3.45	11.15	12.00	12.00	**14.8**
10	2.30	11.30	......	12.20	**14.6**
11	12.00	6.00	1.15	3.45	**14.3**
12,	4.30	10.15	11.00	4.00	**14.1**
13	2.45	6.05	11.45	2.00	**13.59**
14	7.15	8.00	9·30	10.15	**13.55**
15	12.00	13.00	4.15	2.15	**13.53**
16	12.45	.15	6.15	8.00	**13.50**
17	10.15	......	4.30	2.30	**13.48**
18	7.30	8.45	6.15	2.00	**13.45**
19	8.45	12.30	6.15	12.45	**13.43**
	8.15	11.30	10.45	8.30	**13.40**
21	2.00	5.45	3.00	0.00	**13.38**
2	9.00	10.30	......	4.00	**13.35**
23	.30	......	4.30	5.45	**13.33**
24	.00	......	1.00	10.30	**13.30**
25	2.45	6.30	10.30	11.45	**13.27**
26	7.30	11.00	9.15	0.00	**13.25**
27	7.45	11 30	6.15	3.30	**13.22**
28	3.30	10.30	9.00	9.30	**13.19**
29	11.00	10.30	10.45		**13.16**
30	9.15	4.15	9.45	10.30	**13.13**
31	10.00	2.15	11.45	3.00	**13.10**
Total sunshine	207.00	240.15	235.45	200.50	428.47
Per cent of possible sunshine	48.3	56.0	55.	46.8	....

Comparison of Daily Sunshine Records — (*Continued*).

MONTH.	1885.	1886.	1887.	1888.	Possible sunshine.
September 1	6.30	10.00	5.30	0.30	13.8
2	12.15	12.15	....	11.15	13.5
3	8.45	10.45	10.15	8.00	13.2
4	2.15	7.00	12.00	5.15	13.0
5	2.15	6.00	8.45	9.30	12.57
6	7.45	10.45	....	12.00	12.54
7	4.30	10.30	3.30	5.30	12.51
8	0.00	10.15	3.30	0.00	12.49
9	2.30	5.45	....	7.00	12.46
10	4.15	4.45	....	4.00	12.43
11	9.45	10.45	....	3.00	12.40
12	10.15	....	....	0.30	12.38
13	4.45	10.30	....	4.00	12.35
14	8.15	3.30	....	11.30	12.32
15	11.45	8.30	....	5.30	12.28
16	4.15	4.45	....	0.00	12.26
17	11.45	5.45	....	4.30	12.23
18	2.45	10.15	....	5.30	12.20
19	10.30	.15	....	5.30	12.17
20	11.45	7.30	....	5.30	12.14
21	11.30	8.30	....	3.00	12.12
22	6.30	6.15	....	1.45	12.9
23	4.00	5.15	....	7.00	12.6
24	8.15	6.15	....	10.20	12.3
25	11.00	6.00	....	1.20	12.1
26	11.30	....	....	7.25	11.58
27	11.09	.45	....	3.30	11.55
28	11.00	.15	....	3.30	11.51
29	10.30	9.00	....	5.00	11.49
30	9.30	9.30	....	5.45	11.46
Total sunshine	231.30	200.30	43.30	157.05	373.38
Per cent of possible sunshine	62.6	53.7	42.0	42.04	....

It has already been reported* that this instrument is unable to record 10–15 per cent of total sunshine nearest sunrise and sunset, also when there is some haze or smoke, although the sun may not be obscured. The condensed footings from the foregoing table have been combined with similar data for all the sunshine records obtained at this Station.

MONTHLY SUMMARY OF SUNSHINE RECORD, MAY 1, 1885, TO OCTOBER 1, 1888.

		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1885..	Hours..................	......	......	......	......	165.2	237.5	284.75	163.5	206.75	134.5	53.20	50.00
	Per cent of possible..	......	......	......	......	36.4	52.0	53.8	38.1	55.3	39.3	18.1	17.6
1886..	Hours..................	43.25	80.00	83.25	144.75	235.75	252.25	243.25	240.25	200.3	142.75	102.00	68.5
	Per cent of possible..	14.30	26.7	22.3	36.3	51.9	54.2	52.6	56.0	53.7	41.8	34.8	24.2
1887..	Hours..................	44.00	61.50	110.75	159.00	265.00	217.75	267.5	235.75	......	......	......	......
	Per cent of possible..	14.5	18.2	29.7	39.9	58.4	47.6	57.9	55.0	......	......	......	......
1888..	Hours..................	......	......	......	......	......	207.42	270.67	200.83	157.08	......	......	......
	Per cent of possible..	......	......	......	......	......	45.7	58.9	46.8	42.04	......	......	......

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* Station Report, 1885, page 307.

In comparing the record for June, 1888, with previous years, it will be noticed that there was the least sunshine recorded in 1888. More sunshine was recorded for July than in either 1886 or 1887, but less than 1885 by one whole day's sunshine. For August the reverse is true. There was less sunshine in 1888 for this month than for the corresponding months of 1886 and 1887, while the record for 1885 shows August to have been a very cloudy month. The reverse of this was true of September in nearly equal ratios, as there was only 157 hours of sunshine in 1888, as compared with 200 in 1886 and 206 in 1885. If the record could have been continued longer the cloudiness of the latter part of the season of 1888 would have been more noticeable. Nineteen days of October gave an appreciable amount of precipitation, and 18 were recorded as .8, or more cloudy, while rain occurred on nights of five days, which were recorded as having .7 or less of clouds at the time of observation.

READING OF THE AIR THERMOMETERS.

1888.	January.			February.			March.			April.			May.			June.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1........	37.0	41.5	41.6	18.0	25.0	26.2	21.0	34.0	25.0	32.0	38.0	33.0	37.0	39.0	39.0	51.5	59.0	60.7
2........	26.0	24.0	20.6	24.2	28.0	23.0	23.0	30.0	35.6	32.0	35.0	36.6	38.0	47.0	47.0	55.0	58.5	52.8
3........	13.0	23.6	22.0	27.0	29.0	19.7	21.5	21.0	13.0	29.2	34.7	36.0	38.5	54.0	54.0	49.2	59.9	59.0
4........	20.0	24.0	26.0	30.0	33.0	36.2	8.0	11.5	11.5	30.5	45.5	42.8	47.0	62.5	64.0	51.2	68.0	67.5
5........	22.2	21.7	12.8	33.0	33.5	29.0	5.5	12.2	8.0	38.0	46.5	50.5	52.2	53.0	53.5	57.0	76.0	75.5
6	16.7	27.6	33.0	16.0	24.6	20.0	8.0	17.5	10.7	42.0	48.6	48.0	50.0	63.0	62.0	72.2	86.0	79.0
7........	35.5	50.7	35.3	23.5	33.0	32.5	13.5	20.8	20.6	29.2	34.0	30.0	43.8	51.6	48.5	50.0	53.0	59.5
8........	22.0	22.5	21.6	25.0	19.1	13.6	19.0	22.6	23.7	25.0	33.0	32.7	44.0	48.0	53.6	54.5	69.3	71.0
9........	16.2	20.2	14.0	4.0	3.0	—1.5	18.5	29.0	28.5	29.5	42.5	49.0	55.5	70.0	72.0	65.0	82.5	80.0
10........	25.6	27.2	23.7	—1.5	7.0	13.5	26.5	38.0	40.0	41.5	42.0	45.0	61.0	71.5	68.0	70.0	80.0	82.0
11	11.0	13.6	13.2	20.0	24.5	16.5	34.5	37.0	25.0	40.0	42.0	47.7	61.5	74.0	67.0	64.0	56.3	62.6
12........	10.0	12.0	14.5	13.5	22.5	24.8	14.0	11.2	11.0	36.0	41.7	32.8	63.0	60.8	61.0	57.0	68.0	69.0
13........	26.0	36.0	36.0	22.5	37.0	35.0	2.5	6.0	9.5	28.0	39.0	41.0	47.0	57.1	49.0	56.7	75.3	70.0
14........	16.2	25.2	23.0	43.7	44.0	28.0	19.0	22.5	21.0	34.0	39.0	36.0	43.0	45.0	46.0	60.0	74.0	78.8
15........	35.0	31.0	17.2	2.6	2.2	—1.0	20.0	26.2	29.0	34.5	42.5	39.2	41.0	43.0	45.0	65.3	81.6	80.0
16........	10.6	16.1	12.0	—2.5	7.7	20.0	39.0	34.0	32.0	35.0	40.5	39.0	44.0	44.5	43.0	69.0	82.0	79.5
17........	11.8	16.0	23.0	28.5	31.2	28.7	18.0	18.5	17.0	34.7	43.0	42.0	43.5	51.0	53.0	68.5	81.0	81.2
18........	18.2	15.5	16.0	23.2	27.0	27.0	12.5	22.2	24.0	39.0	53.5	43.0	46.0	51.0	47.0	74.0	81.8	78.2
19........	12.0	16.5	14.6	25.5	35.0	40.0	26.8	42.0	45.0	36.0	47.0	40.7	48.0	51.0	50.0	63.0	80.0	78.8

20........	12.0	9.7	4.0	40.8	44.8	37.3	41.5	48.8	49.0	32.5	40.0	38.8	43.0	50.0	54.0	68.0	87.0	82.0
21........	5.5	3.0	—1.8	28.0	30.0	30.0	39.0	42.0	34.0	32.7	39.5	38.0	47.0	58.8	64.0	72.0	91.8	87.8
22........	—2.0	7.5	0.8	21.0	29.0	30.0	23.0	24.0	17.0	35.5	43.5	43.0	47.0	69.8	69.5	77.5	90.2	86.6
23........	1.0	16.0	15.5	28.0	28.0	35.0	8.0	13.7	11.5	34.7	44.1	42.7	52.5	69.0	68.5	79.6	88.0	75.0
24........	11.0	10.0	5.5	27.2	38.0	38.0	9.0	15.3	16.0	30.6	35.0	36.3	56.0	69.5	68.0	75.7	82.0	72.3
25........	6.0	20.8	20.0	36.0	40.0	41.0	12.0	25.5	28.0	35.0	48.0	47.7	59.0	66.0	63.3	72.0	77.5	76.5
26........	17.0	10.5	14.0	27.2	28.0	22.0	32.0	34.0	39.0	43.2	63.5	64.0	55.5	64.5	60.5	63.0	70.0	69.4
27........	6.5	5.0	3.0	12.2	15.0	12.0	38.8	52.0	50.0	48.0	74.0	73.8	57.5	74.0	68.0	59.0	68.5	67.2
28........	2.0	4.7	6.0	5.0	12.0	12.5	38.2	52.0	37.0	77.0	78.5	77.0	65.0	64.0	70.0	57.3	55.0	56.0
29........	8.5	14.8	15.0	20.0	30.0	29.0	28.6	35.0	38.0	56.0	80.5	74.0	63.5	65.0	69.2	53.0	57.7	64.4
30........	19.0	25.2	23.0	. ..	...	....	32.0	41.0	40.3	41.0	57.7	44.0	64.0	71.0	61.6	63.0	72.0	72.0
31........	23.0	26.0	19.7	....	....	....	33.0	40.0	38.0	....	....	....	53.5	76.5	55.5	....	....	......

READING OF THE AIR THERMOMETERS — (*Continued*).

1888.	JULY.			AUGUST.			SEPTEMBER.			OCTOBER.			NOVEMBER.			DECEMBER.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1........	55.5	62.8	60.7	75.0	75.0	73.4	58.0	57.5	59.0	43.8	47.0	51.2	58.2	67.0	61.0	27.5	27.7	29.0
2........	59.0	72.0	70.5	60.0	79.5	74.0	54.5	69.6	66.5	43.0	42.0	39.5	55.0	64.0	70.0	26.0	37.0	36.0
3........	61.0	78.2	....	64.0	83.0	83.0	55.0	74.0	70.0	35.0	40.3	36.8	47.0	45.5	41.6	30.5	31.6	30.0
4........	69.0	85.5	86.0	71.5	84.7	82.7	61.0	75.7	75.5	38.0	41.5	47.0	36.7	48.5	49.0	30.0	34.6	32.5
5........	71.0	81.6	78.0	66.5	75.8	74.6	55.0	61.0	54.5	48.3	60.0	52.0	52.0	....	....	37.5	41.0	36.3
6........	66.2	79.0	78.7	67.5	82.5	84.0	45.0	59.0	55.2	45.0	47.0	47.0	58.5	68.0	55.0	24.0	25.0	25.5
7........	74.4	78.8	74.5	74.0	82.5	80.4	47.0	63.3	62.0	42.0	49.0	47.0	40.2	46.0	38.0	26.0	42.0	33.0
8........	60.7	73.1	67.5	69.5	88.7	76.3	55.0	66.0	70.0	45.0	44.5	40.0	40.5	44.2	44.0	34.0	37.5	32.5
9........	60.5	72.2	68.0	62.0	71.4	69.0	63.0	80.0	72.0	34.0	36.5	37.3	56.0	69.5	44.4	33.0	33.0	32.0
10........	59.0	76.8	76.0	61.0	70.5	68.0	56.0	68.0	63.3	38.3	45.0	40.0	44.0	44.0	47.5	33.0	34.0	35.0
11........	70.0	82.7	73.0	57.8	65.0	66.3	52.0	70.5	69.0	32.3	48.0	44.0	46.0	38.0	37.0	30.0	33.0	34.5
12........	56.0	57.8	62.0	56.0	66.0	65.5	60.0	75.0	68.0	40.0	43.8	45.0	38.0	38.2	33.0	21.0	24.7	24.0
13........	54.4	69.0	70.0	57.0	59.3	60.0	51.0	56.2	54.0	40.5	49.0	46.0	36.4	50.0	43.0	15.5	16.2	18.0
14........	59.0	70.6	70.4	59.0	72.2	73.0	46.5	62.0	61.0	40.2	43.2	41.0	37.0	57.0	50.0	11.0	14.0	18.0
15........	55.0	73.7	71.0	64.0	80.5	76.0	52.0	69.0	65.0	35.0	50.0	46.0	46.0	47.0	49.0	14.0	25.0	35.0
16........	56.7	76.3	75.0	70.0	87.0	86.0	59.0	65.8	65,0	44.5	57.8	47.0	37.0	37.0	33.0	34.5	40.0	40.5
17........	62.0	78.0	78.0	67.5	75.3	72.0	60.0	74.0	64.5	44.0	53.8	46.0	30.0	30.0	26.0	41.7	43.4	39.0
18........	64.0	72.0	64.7	61.3	69.0	68.0	63.0	73.5	66.0	41.0	47.8	39.5	22.0	....	35.0	23.0	22.0	19.5
19........	63.8	77.5	69.0	63.0	76.5	74.5	58.5	70.0	65.5	38.0	48.5	48.5	38.5	45.0	40.0	14.0	14.0	11.7

20........	64.3	71.0	70.0	62.0	72.0	65.5	58.8	67.0	61.2	42.0	44.8	40.0	29.5	27.2	21.0	12.0	16.0	18.0
21........	60.5	76.0	75.2	61.7	72.0	66.0	53.9	62.4	59.5	32.2	33.8	33.0	17.0	26.5	24.0	27.0	28.0	12.0
22........	64.0	82.0	....	54.5	57.8	59.0	53.8	60.0	58.5	31.0	41.0	40.0	24.0	28.0	20.0	5.0	15.0	11.5
23........	67.0	77.5	78.0	53.2	65.0	63.5	54.2	61.0	56.5	....	47.0	50.0	11.0	26.5	30.0	21.0	39.0	35.0
24........	67.0	75.2	72.5	68.0	78.0	73.5	47.0	66.0	63.5	44.2	49.0	46.0	24.0	40.0	32.0	35.0	43.0	41.0
25........	65.2	78.5	74.2	69.0	81.0	78.0	50.5	60.5	56.3	37.0	54.0	54.5	27.0	30.0	27.0	41.0	42.0	......
26........	62.0	78.0	74.0	66.0	84.5	81.5	47.0	65.0	60.0	42.3	58.0	53.0	25.0	30.0	32.0	39.0	51.0	45.5
27........	65.0	74.4	71.0	60.0	60.3	61.0	54.0	60.4	53.0	46.5	56.0	54.6	33.8	35.0	33.5	46.0	38.0	33.0
28........	64.6	78.0	74.2	53.0	67.8	64.8	44.0	49.0	45.0	52.5	41.1	43.0	34.0	37.5	35.0	29.0	30.0	31.8
29........	62.7	80.5	76.2	59.0	73.0	73.0	37.5	49.0	42.0	39.3	46.0	41.0	34.0	35.0	34.5	28.0	36.0	30.0
30........	65.0	82.2	81.0	60.0	78.0	79.9	36.5	48.0	45.0	35.2	39.2	35.0	34.5	39.0	36.0	25.0	40.0	38.0
31........	69.5	89.0	71.0	65.0	80.0	71.0	....	....	....	41.5	69.0	60.0	....	....	....	35.0	38.0	36.0

READINGS OF THE MAXIMA AND MINIMA THERMOMETERS, 7 A. M.

1888.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER		OCTOBER.		NOVEMBER.		DECEMBER.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1....	37.2	10.0	27.0	9.0	32.0	19.0	43.7	30.0	59.0	35.5	69.0	50.0	74.5	52.8	91.6	58.0	83.0	57.0	50.0	41.4	73.0	41.0	40.0	26.6
2....	43.2	25.2	29.0	17.5	34.8	19.5	40.0	32.0	40.8	33.8	64.5	41.6	67.0	50.0	77.8	56.0	60.0	43.0	54.0	42.5	70.5	52.7	31.5	23.5
3....	26.6	12.6	29.0	19.7	42.0	20.5	39.0	27.0	50.0	29.0	64.5	40.5	73.0	53.5	81.2	55.0	75.5	50.5	?	33.3	73.0	41.7	38.0	30.0
4....	25.0	11.8	30.0	10.0	21.8	6.3	39.8	26.7	58.2	43.0	62.0	40.0	81.6	53,0	87.0	64.0	78.0	55.0	?	32.8	47.6	35.5	33.0	28.5
5....	27.0	19.3	38.0	28.6	12.0	4.5	50.0	32.0	67.2	50 0	71.0	45.5	89.8	67.6	87.7	65.0	82.0	54.0	50.8	38.0	54.0	36.0	38.0	28.5
6....	23.7	4.5	34.8	15.0	13.5	4.0	57.0	37.0	58.2	39.5	80.0	58.0	83.5	60.0	77.0	63.6	72.7	40.5	62.7	43.7	66.0	51.5	41.0	23.0
7....	35.8	15.5	28.0	15.0	17.8	7.0	51.0	28.7	66.7	38.6	89.3	49.8	83.6	....	88.0	67.0	66.0	40.0	48.3	39.5	69.0	39.7	30.0	23.0
8 ...	31.4	21.5	34.0	24.0	21.0	12.5	49.0	19.0	53.0	43.0	60.0	42.0	83.0	54.7	85.3	64.3	68.0	46.0	51.3	41.0	47.0	36.7	43.0	25.5
9....	24.8	15.2	25.2	2.5	24.7	16.6	38.0	24.8	56.0	43.0	73.0	54.0	74.0	59.0	92.6	60.5	73.2	60.5	47.5	33.2	56.2	39.0	38.0	31.5
10....	26.0	12.0	5.0	—7.0	32.5	17.0	51.5	33.7	76.0	55.0	85.8	63.7	74.5	51.5	76.0	53.0	83.0	53.0	39.0	32.2	70.0	41.8	36.5	31.0
11....	31.0	9.0	20.0	—3.5	43.5	26.0	50.0	33.0	75.0	56.0	85.6	58.5	82.6	59.0	70.5	52.0	70.0	49.0	48.5	30.0	57.0	36.0	36.0	28.0
12....	16.8	5.5	24.5	12.5	38.0	13.0	50.0	34.5	75.5	58.0	64.8	49.2	85.6	51.5	70.7	55.0	75.0	51.5	48.5	36.5	38.2?	32.0	36.5	20.0
13....	26.0	9.0	25.8	12.5	14.0	0.0	43.0	23.0	79.8	43.5	72.0	50.0	65.5	49.0	69.8	54.8	78.5	49.0	40.6	36.5	40.5	32.0	35.0	14.5
14....	43.0	4.6?	46.7	21.7	19.0	1.0	42.0	28.0	60.0	37.0	76.7	56.0	73.0	52.0	60.3	54.3	61.0	41.0	51.0	39.7	53.0	36.5	17.0	9.5
15....	36.0	22.0	46.7	1.5	24.0	18.0	40.0	33.0	48.0	38.6	81.0	55.6	74.5	50.7	76.0	59.0	66.0	47.0	46.5	33.3	61.5	36.5	19.0	13.0
16....	36.0	9.5	3.0	—4.0	41.0	19.5	45.0	30.5	48.0	39.0	84.2	63.0	76.0	47.0	84.0	63.0	72.6	46.5	51.3	43.0	52.6	36.5	35.5	14.0
17....	36.0	5.5	35.5	—2.5?	40.0	17.0	42.2	27.7	48.7	36.3	84.0	58.0	78.6	51.5	89.0	66.3	....	59.0	60.0	42.5	38.0	28.5	45.0	33.0
18....	27.0	10.0	32.2	22.0	21.0	8.5	46.0	33.3	66.5	41.0	87.0	65.2	80.5	51.0	81.0	59.0	75.0	62.3	54.4	39.7	33.0	19.5	45.0	20.0
19....	18.3	9.5	29.2	22.0	27.5	11.5	54.0	29.5	53.8	47.5	83.5	56.0	72.0	50.5	72.0	56.5	76.0	57.0	48.8	32.5	38.5	21.0	23.0	13.0
20....	17.7	10.5	41.2	24.0	48.8	26.0	50.0	31.5	53.2	40.0	83.5	55.3	68.5	58.6	81.0	58.8	71.0	56.0	52.2	37.0	47.3	29.0	14.0	10.0

21....	**12.0**	**2.8**	**49.0**	**27.0**	**55.0**	**37.0**	**42.0**	**31.2**	**56.0**	**37.0**	**89.2**	**64.5**	**73.7**	**53.0**	**74.5**	**55.5**	**69.9**	**51.0**	**44.8?**	**31.7**	**29.8**	**14.0**	**27.0**	**11.0**
22....	5.5	—4.6	32.0	25.0	56.0	22.0	42.0	31.7	62.5	39.6	92.0	69.6	81.0	55.2	72.0	53.8	65.3	52.0	34.6	29.0	29.0	18.5	30.0	4.0
23....	8.3	—6 0	34.6	24.5	24.5	6.0	47.0	31.0	75.0	45.5	94.1	74.6	84.2	63.5	63.0	48.3	65.8	53.0	47.2?	38.0	30.0	8.0	22.0	5.0
24....	22.0	—1.0	42.0	26.0	15.0	6.0	46.6	29.0	73.0	52.0	91.5	68.0	79.5	62.5	68.0	57.0	63.0	45.5	50.6	43.3	31.5	11.0	44.0	21.0
25....	12.0	—5.0	41.5	26.5	18.3	8.0	39.0	28.0	74.8	52.0	....	66.5	77.2	57.2	81.0	57.0	70.5	45.6	50.8	34.8	41.0	23.0	48.0	35.0
26....	26.0	3.5	42.2	26.5	32.6	12.0	53.6	28.0	69.0	54.0	79.0	61.5	79.5	53.5	84.5	59.0	61.5	41.3	60.3	41.0	31.0	21.2	48.0	38.0
27....	17.0	5.5	34.0	11.5	41.7	30.0	67.5	38.3	64.5?	52.5	73.0	49.5	80.8	61.2	86.0	60.0	66.6	41.0	59.0	40.5	34.2	24.5	53.0	38.0
28....	7.0	0.0	22.7	3.0	57.0	36.8	79.0	46.5	77.0	57.0	79.0	57.0	75.5	56.0	64.7	48.7	67.0	43.0	57.0	46.0	35.0	32.5	51.0	28.0
29....	9.0	—1.5	20.0	10.0	52.0	27.5	82.5	48.7	75.0	58.8	58.0	51.0	80.8	58.5	70.0	54.5	53.6	35.0	53.0	38.0	39.0	32.5	33.5	28.0
30...	19.0	12.0	....	....	41.0	27.0	81.5	38.5	71.7	55.0	66.4	55.0	82.0	59.0	77.0	56.0	50.0	33.5	49.0	33.7	36.5	33.0	37.0	23.0
31....	26.0	17.0	....	....	50.0	31.5	....	....	74.0	46.0	....	....	86.0	59.0	83.3	60.0	....	....	49.3	31.7	....	....	44.5	24.0

READING OF SOIL THERMOMETERS.

1888.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S.		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
April 1	32.5	45.0	32.5	32.5	40.9	33.0	32.7	38.0	34.5	32.7	36.0	35.0	32.6	34.0	33.0	32.6	32.7	33.5	33.0	33.0	33.0
2	....	40.0	37.0	....	37.0	36.0	....	36.0	36.5	....	35.3	36.5	....	34.0	35.5	....	33.4	34.0	....	33.0	33.0
3	32.3	57.5	43.0	31.0	40.0	41.0	32.7	38.5	44.0	33.0	35.5	43.0	33.0	33.3	40.5	33.0	33.0	36.5	33.0	33.0	33.5
4	32.5	64.5	46.0	32.2	48.0	45.6	33.0	46.0	47.0	33.6	41.0	46.0	33.5	36.7	43.7	34.0	34.5	38.7	33.5	33.8	34.0
5	35.0	45.0	49.0	35.5	45.0	47.0	35.0	41.5	46.0	35.5	39.0	44.0	36.0	39.0	44.0	36.0	36.0	44.0	34.5	35.0	35.0
6	43.0	62.0	44.0	41.5	51.0	45.0	42.5	50.0	46.7	43.0	47.0	47.0	42.5	44.0	46.0	40.0	40.0	43.0	37.5	38.0	38.6
7	33.0	51.0	37.0	33.2	43.5	37.5	35.0	42.3	39.6	36.2	40.5	41.0	37.0	38.7	40.5	38.0	38.5	40.0	39.0	38.7	38.5
8	31.5	58.0	38.0	32.0	41.5	39.8	32.5	39.5	41.0	34.0	36.4	42.0	34.5	34.5	40.5	36.6	36.0	38.0	37.8	37.5	37.5
9	32.5	36.3	47.0	32.3	48.8	36.7	32.8	43.6	47.0	33.0	39.8	46.0	34.5	37.0	44.0	36.5	36.5	39.6	37.3	37.5	37.6
10	40.0	43.0	43.5	38.7	41.5	42.0	38.0	41.0	42.0	38.2	40.0	41.0	38.0	39.0	40.5	37.7	37.8	38.7	38.2	38.0	38.5
11	39.0	43.0	43.5	38.5	40.0	44.0	38.0	41.0	44.5	39.5	40.2	44.0	39.5	39.5	42.0	40.0	38.6	40.7	39.0	39.0	39.0
12	35.0	51.0	35.5	35.3	47.0	38.5	35.7	44.6	41.0	36.5	42.5	42.3	37.0	40.0	42.0	38.0	38.0	41.0	39.0	39.0	39.2
13	32.5	64.0	43.0	30.7	47.3	42.0	32.2	41.0	43.2	34.0	37.2	43.0	35.0	34.7	42.0	37.0	36.5	39.0	38.8	38.5	38.5
14	35.5	41.0	38.0	36.0	39.5	38.0	36.0	39.0	38.5	37.0	38.8	39.0	37.5	38.0	39.0	38.0	38.5	39.0	39.0	39.0	39.0
15	36.0	61.0	45.0	36.0	48.0	44.5	36.2	44.0	46.0	36.6	43.0	45.7	36.5	40.0	44.0	37.0	39.0	40.5	38.5	37.8	39.0
16	41.0	65.0	42.0	37.5	49.5	44.3	37.0	48.0	46.5	37.0	44.8	47.0	37.0	41.5	45.5	38.0	39.8	43.0	39.5	39.5	40.0
17	34.0	67.5	45.0	34.5	54.2	45.0	34.5	49.0	45.7	36.0	44.8	46.0	36.5	41.5	45.0	39.0	39.7	45.0	40.0	40.0	40.5
18	39.5	62.0	45.0	39.0	51.0	45.6	39.8	48.0	47.0	40.0	45.2	47.7	40.0	43.0	40.5	41.0	41.2	41.0	40.8	41.0	41.8
19	39.5	67.5	46.0	37.2	52.8	46.0	36.5	49.3	47.3	37.3	45.7	47.0	38.5	43.0	46.5	39.7	40.4	44.3	41.5	41.5	41.6
20	37.5	57.0	40.0	37.3	47.7	41.0	38.0	45.2	42.3	39.0	43.0	43.0	39.5	41.0	43.0	40.0	40.0	42.5	41.8	41,7	41.

21	33.0	51.0	39.5	34.5	45.0	41.0	35.0	43.0	41.2	36.0	41.0	42.5	37.0	39.0	42.0	38.3	39.5	40.5	41.0	40.7	40.8
22	35.0	52.2	44.0	34.7	47.7	45.0	34.3	45.2	46.0	35.0	42.2	45.6	36.0	41.0	44.0	38.5	38.4	42.0	40.0	40.1	40.6
23	34.0	65.0	46.0	35.0	52.0	46.3	34.8	48.1	48.3	36.0	44.8	47.7	37.0	42.0	46.0	38.2	40.0	42.5	40.8	40.5	41.0
24	34.0	58.5	43.5	35.0	46.0	43.0	35.2	43.6	44.8	37.0	41.6	45.0	37.5	40.0	43.5	39.0	39.0	41.0	41.5	41.0	41.0
25	37.0	77.5	53.0	34.7	54.7	52.0	34.3	48.6	53.2	35.6	45.0	52.0	36.5	41.5	49.0	38.0	38.7	44.7	41.0	40.7	41.2
26	43.2	84.0	61.0	42.2	61.0	57.7	42.0	54.0	60.0	42.0	50.0	57.8	42.0	46.5	54.0	42.6	43.8	48.5	42.2	42.5	43.0
27	51.0	90.0	69.0	46.3	68.0	66.0	45.0	60.0	66.6	45.0	55.0	64.0	45.0	50.5	59.5	45.7	46.8	52.0	44.6	44.6	45.5
28	55.0	98.0	74.0	52.5	73.0	71.0	51.5	66.0	71.5	51.2	61.0	69.0	50.5	56.0	64.0	50.0	51.5	55.5	47.0	47.5	48.0
29	59.5	97.0	71.5	54.7	73.5	70.0	54.2	68.8	71.5	54.0	64.0	69.7	53.7	59.3	65.5	53.0	54.1	58.8	49.5	49.9	50.8
30	....	....	...	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

READING OF SOIL THERMOMETERS—(*Continued*).

1888.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
May 1	44.0	49.0	45.0	45.5	47.5	45.8	46.2	47.5	46.8	47.8	48.0	47.5	48.8	48.0	47.5	50.6	49.6	49.0	50.6	49.8	49.0
2	42.5	79.0	55.0	42.0	67.7	55.0	42.0	53.2	56.8	43.0	51.0	56.2	43.7	48.0	54.0	46.0	47.0	50.8	48.0	47.6	47.8
3	47.0	80.5	55.5	42.0	60.7	54.5	41.5	54.0	55.8	42.0	51 0	55.7	43.0	48.0	54.0	46.0	46.6	50.8	47.8	47.5	48.0
4	50.5	78.0	62.0	47.0	61.5	60.0	47.0	57.0	60.0	47.5	54.0	59.0	47.5	51.0	....	48.5	49.0	52.5	48.2	48.0	48.5
5	51.0	55.0	54.7	50.0	53.0	53.5	50.0	52.6	53.8	51.0	52.0	55.5	51.0	51.0	54.5	51.0	50.6	52.0	49.0	49.5	50.2
6	52.0	80.1	63.5	47.5	65.0	62.5	46.2	60.5	62.5	45.7	56.8	61.0	46.0	53.0	59.0	48.0	49.9	54.5	48.7	48.8	49.5
7	47.0	80.0	58.0	46.0	62.0	57.2	46.2	59.5	59.0	47.0	55.5	58.5	48.0	52.0	57.5	50.0	50.2	53.5	50.0	49.7	50.0
8	47.0	51.5	52.0	48.0	51.0	52.2	48.0	50.5	52.2	48.8	50.0	52.0	49.5	49.8	51.0	50.2	50.0	50.5	50.0	49.8	49.6
9	55.0	81.0	69.0	52.3	68.5	67.5	51.0	64.0	67.0	50.2	59.6	65.0	49.5	55.5	62.0	50.0	51.5	56.2	49.5	49.5	50.5
10	61.5	72.0	68.0	59.3	70.0	67.5	59.0	67.5	67.5	58.0	64.5	66.0	57.0	61.0	63.5	55.5	56.8	59.2	52.0	52.5	53.0
11	62.0	89.0	68.0	60.0	70.7	66.5	59.0	68.2	67.0	58.5	64.8	66.0	58.0	61.5	64.0	57.2	58.0	60.2	54.0	54.3	55.7
12	66.0	65.0	62.2	61.0	64.0	61.8	60.6	64.0	62.4	66.0	63.0	62.5	59.0	61.0	61.5	58.5	58.8	59.6	55.0	55.0	55.0
13	51.5	79.0	54.0	49.7	68.7	56.0	50.0	64.1	58.0	51.0	59.9	59.0	52.0	57.0	59.0	54.0	55.0	57.8	54.2	54.0	54.2
14	47.0	53.0	50.0	46.7	52.5	51.3	46.7	51.5	51.8	48.0	51.0	52.0	49.0	50.5	51.8	52.0	51.7	52.0	53.7	53.0	52.2
15	44.0	50.0	49.0	44.0	48.0	49.0	44.7	48.0	50.0	46.0	48.0	50.6	47.0	48.0	50.5	49.3	49.3	50.2	51.2	50.8	50.8
16	44.0	54.5	45.5	42.8	52.2	46.5	44.0	48.2	48.0	45.0	47.3	49.0	45.5	47.0	49.0	48.0	48.0	49.4	50.0	49.6	50.5
17	44.0	64.0	57.0	44.3	56.2	56.0	42.0	53.0	57.0	41.5	50.2	56.0	42.2	48.0	53.5	45.5	47.0	50.8	48.8	48.5	49.0
18	49.0	53.0	49.0	48.0	51.5	48.5	47.0	50.5	49.0	47.2	50.0	49.0	47.5	49.0	49.0	49.0	49.0	49.0	49.6	49.5	49.0
19	50.0	59.0	50.5	49.2	56.4	51.0	49.0	55.5	51.5	49.0	54.0	52.0	49.0	52.0	51.5	49.2	50.0	51.0	49.3	49.4	49.8
20	44.0	46.0	47.5	43.5	46.8	56.0	43.7	55.0	56.8	44.5	52.2	56.5	45.5	50.3	55.0	47.7	48.9	52.0	49.0	49.1	49.8

21................	50.0	69.5	65.5	50.0	67.5	62.0	46.7	63.7	64.2	46.0	58.0	53.0	46.0	53.5	60.0	48.6	50.2	55.0	50.0	50.0	50.4
22................	51.5	85.0	70.0	50.8	70.6	67.5	49.7	67.0	68.2	49.8	61.3	67.0	50.0	56.5	63.5	50.6	53.0	57.6	51.4	51.6	52.0
23................	56.0	83.0	69.5	53.0	73.0	68.5	52.7	69.0	68.4	53.0	64.0	67.0	53.0	59.0	64.0	54.3	55.0	59.0	53.0	53.0	53.8
24................	59.0	88.0	73.5	57.0	73.7	72.0	56.5	69.8	73.0	56.8	65.0	71.6	56.2	61.0	68.0	56.2	57.2	61.8	54.4	54.6	55.0
25................	62.0	75.0	66.0	59.7	68.0	65.7	58.3	65.2	65.0	58.0	63.0	64.2	57.5	60.5	63.5	58.0	58.2	59.8	56.0	55.7	56.0
26................	57.5	74.0	62.0	56.8	66.3	62.0	57.0	64.0	63.0	57.6	61.6	63.0	57.5	59.3	62.0	57.5	57.5	59,6	55.8	55.6	55.8
27................	55.2	83.0	69.5	58.0	78.0	70.0	57 0	72.8	70.0	56.3	68.0	69.0	56.5	63.5	67.0	57.0	59.0	62.6	55.2	55.8	56.6
28................	67.5	66.0	70.5	65.0	65.0	71.0	63.3	64.6	71.0	62.0	64.0	70.0	61.0	62.5	68.0	60.3	60.5	63.2	57.6	57.5	57.8
29................	65.0	66.8	71.0	62.2	65.5	70.0	61.0	64.3	69.7	61.0	64.0	68.8	60.8	62.5	67.0	61.0	61.0	63.2	60.7	58.5	58.7
30................	65.0	80.0	67.0	61.0	76.8	66.5	60.5	73.5	68.0	60.0	70.0	67.8	59.5	66.0	66.5	60.6	62.0	64.0	59.0	59.0	59.2
31................	57.5	89.0	62.0	57.0	72.4	62.5	56.2	69.5	63.6	56.6	65.0	63.5	57.0	62.0	63.0	59.0	59.6	61.5	59.0	58.7	58.7

READING OF SOIL THERMOMETERS — (*Continued*).

1888.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
June 1	57.0	71.0	61.0	56.7	66.2	61.0	55.7	66.3	63.7	56.0	63.0	64.0	56.5	60.5	63.0	58.0	57.6	61.0	58.0	58.0	58.0
2	58.5	74.0	59.0	57.0	63.0	59.0	53.7	60.6	60.0	53.0	57.0	60.0	53.5	55.5	59.0	56.2	56.2	59.0	58.0	57.0	57.0
3	52.0	74.0	65.0	52.0	69.5	65.0	50.5	67.5	67.0	50.5	62.0	66.0	51.5	58.5	63.5	54.2	56.0	60.0	56.0	56.0	56.6
4	55.0	83.0	70.0	54.3	74.7	69.6	52.3	71.3	71.0	52.2	65.0	70.0	53.0	60.5	67.0	56.0	67.5	62.0	57.0	56.8	57.0
5	60.3	87.0	76.0	58.0	77.5	74.0	56.0	75.5	74.8	55.6	69.0	73.2	56.0	63.5	64.3	58.0	59.6	64.3	58.0	58.0	58.4
6	67.5	101.5	80.0	64.8	81.7	79.0	63.7	80.5	80.3	62.5	74.3	78.8	61.5	68.5	74.7	61.5	63.0	68.0	59.5	59.5	60.2
7	58.0	64.5	63.0	58.5	62.0	64.0	60.1	61.6	64.5	61.0	61.0	64.0	61.7	60.6	62.5	63.0	61.5	61.5	61.0	60.6	60.0
8	58.0	96.5	72.0	57.0	77.8	72.5	54.6	75.3	74.0	54.0	68.6	73.0	54.7	63.3	70.0	57.7	59.3	64.7	59.0	58.8	59.0
9	65.0	96.0	78.0	63.0	81.0	77.0	61.0	78.0	78.0	60.0	73.0	76.6	60.2	68.0	73.5	61.0	63.0	67.5	60.0	60.0	61.8
10	70.0	91.5	81.5	69.0	79.0	79.5	66.2	76.8	80.2	66.0	73.1	78.3	66.5	69.5	75.0	64.7	65.8	69.0	61.2	61.8	62.5
11	65.0	68.0	64.0	63.6	66.7	66.3	63.6	67.0	68.0	64.0	66.0	68.0	64.5	65.0	67.0	65.0	64.3	65.0	62.7	62.5	62.0
12	62.0	96.0	69.5	58.3	79.0	71.0	57.0	76.7	71.5	56.8	70.3	72.6	57.8	65.5	70.5	60.3	62.0	66.2	61.0	60.5	62.0
13	61.5	93.0	72.0	59.3	76.3	71.2	58.5	71.8	71.8	59.2	68.8	71.0	60.0	65.0	69.3	61.8	62.5	65.5	61.0	61.0	61.0
14	61.0	82.0	76.5	60.8	76.0	77.0	62.8	73.0	77.0	63.2	69.0	75.2	63.0	66.0	72.5	63.3	64.6	67.3	61.0	61.0	61.7
15	66.0	86.0	76.0	66.0	81.0	76.5	66.0	78.0	76.5	66.0	73.0	76.0	65.5	69.5	73.5	62.6	66.0	69.0	61.8	62.5	63.0
16	69.0	94.0	81.5	67.8	85.5	82.0	66.5	83.5	83.2	66.0	77.0	82.0	66.0	72.0	78.5	66.0	67.5	72.0	64.0	64.0	64.5
17	70.7	100.2	85.0	68.7	88.3	85.3	67.0	86.1	86.0	66.0	79.6	84.5	66.0	73.8	84.0	67.0	68.7	74.0	64.7	64.9	66.0
18	75.7	107.5	83.0	73.2	92.5	84.8	72.0	90.2	86.5	70.5	83.0	85.7	70.0	77.5	82.5	69.7	71.6	76.0	66.7	67.0	67.5
19	69.5	103.0	82.0	67.8	88.0	83.3	67.0	84.8	84.3	67.0	79.0	83.5	67.5	74.0	81.5	69.0	70.0	84.7	67.6	67.0	67.7
20	72.0	107.0	87.5	70.0	91.0	86.5	68.0	88.0	86.5	67.5	81.0	85.3	68.0	75.5	82.0	69.0	70.5	75.8	67.5	67.0	67.8

21	76.0	112.0	88.0	73.0	94.7	88.0	72.0	91.0	88.6	72.0	84.0	87.0	71.5	78.5	84.0	71.5	73.0	77.2	68.5	67.5	69.0
22	79.0	112.0	91.5	76.0	94.5	91.0	74.6	91.3	91.3	73.8	75.6	90.0	73.5	80.3	86.5	73.0	74.5	79.3	69.5	69.6	70.0
23	83.0	98.0	79.5	79.0	94.0	79.0	77.8	93.2	80.0	77.0	88.0	81.0	76.0	82.5	80.0	75.0	76.5	77.5	70.8	70.5	70.8
24	79.0	88.0	76.0	75.0	85.0	76.7	74.0	82.8	77.5	72.5	80.6	77.0	71.5	77.0	76.7	72.0	73.7	75.0	69.5	70.0	70.0
25	73.0	88.0	72.0	71.0	88.0	76.0	70.6	82.0	77.0	70.0	78.2	77.0	70.0	75.0	76.7	71.0	72.0	73.2	69.7	69.2	68.7
26	67.0	79.0	70.0	67.0	74.5	71.7	67.0	72.5	73.0	68.0	71.0	73.0	69.0	69.5	72.0	70.0	69.2	70.8	69.0	68.2	68.0
27	65.5	85.0	71.0	62 4	78.0	72.5	62.2	77.8	73.0	61.2	72.5	73.0	62.5	69.0	72.0	65.8	67.0	70.0	67.5	66.6	67.0
28	61.0	49.0	58.0	61.6	59.6	59.0	62.0	60.0	60.0	63.2	61.3	61.0	64.0	62.5	62.0	66.6	65.0	64.0	66.5	66.0	65.0
29	57.5	67.0	68.0	57.0	64.0	67.0	57.0	63.0	67.5	58.0	62.0	67.0	58.5	61.0	66.0	61.0	62.5	64.0	63.3	63.0	63.0
30	65.0	76.5	73.0	61.8	73.1	72.0	61.0	71.7	73.0	60.8	69.0	72.5	61.0	66.2	70.5	62.5	63.7	67.6	63.0	63.0	64.0

READING OF SOIL THERMOMETERS — (*Continued*).

1888.	SURFACE.			ONE INCH.			TWO INCHES,			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
July 1	59.0	75.1	69.0	59.0	71.5	70.0	59.7	68.6	71.0	60.5	65.8	71.0	61.0	63.5	69.5	63.7	63.2	66.6	64.0	63.7	64.0
2	63.0	93.0	74.0	63.0	80.8	75.0	61.0	79.8	77.0	60.4	72.9	76.5	61.0	68.0	74.0	63.3	64.7	69.6	64.2	63.5	65.0
3	64.0	92.8	76.5	63.0	81.9	77.2	61.0	79.8	79.0	62.0	74.3	78.2	63.0	69.4	75.5	65.0	65.8	71.0	65.0	64.8	65.2
4	70.0	102.0	85.0	68.0	85.5	84.0	66.5	83.5	84.8	66.0	77.5	83.0	66.0	72.5	79.5	67.0	68.3	73.5	66.0	65.8	67.0
5	71.5	101.5	78.0	71.6	88.0	78.5	71.5	84.8	82.0	71.5	80.0	81.8	71.0	74.0	79.5	70.6	71.7	75.0	68.0	67.7	67.5
6	70.0	105.0	73.0	68.0	87.0	83.0	68.4	85.2	84.0	67.0	79.0	83.0	67.5	74.0	80.0	69.4	70.0	75.0	68.5	68.0	68.6
7	76.0	109.8	79.0	73.0	88.0	81.4	72.0	87.2	84.0	71.5	81.6	83.6	71.0	76.5	81.0	71.5	72.0	76.0	69.0	68.6	69.5
8	63.0	99.8	72.0	64.7	84.0	74.0	65.0	81.2	75.0	65.7	76.1	75.0	66.5	72.0	74.0	69.0	69.7	72.0	68.7	68.3	69.0
9	64.0	98.0	73.0	65.0	80.2	74.0	65.8	77.0	75.7	66.5	73.7	75.6	67.0	70.5	74.0	68.7	68.7	71.8	68.0	67.6	68.0
10	66.0	101.5	80.0	62.5	84.1	80.0	62.6	81.2	81.3	63.3	75.5	80.7	64.5	71.0	78.0	67.0	68.0	73.0	67.8	67.0	68.0
11	71.6	109.9	72.5	69.0	87.0	74.4	68.5	84.8	77.0	68.0	79.6	78.0	68.0	74.5	77.0	69.5	70.5	74.0	68.5	68.0	68.7
12	59.0	68.1	65.0	57.7	64.2	67.0	58.0	64.5	69.0	60.2	64.0	69.5	62.0	64.0	68.5	66.5	65.5	67.7	68.0	66.7	66.5
13	58.0	98.0	74.0	57.0	77.0	74.8	57.3	76.0	76.0	58.3	70.0	75.5	59.5	66.0	73.0	63.0	64.5	69.0	65.5	65.0	65.5
14	62.6	103.0	78.0	61.0	81.7	78.0	61.0	79.7	79.5	61.5	74.0	78.5	62.5	69.0	76.0	65.0	66.0	71.0	66.0	65.6	66.0
15	60.5	100.9	74.0	60.2	82.0	77.0	61.2	78.2	79.0	62.7	73.0	76.5	63.7	69.1	76.0	66.2	66.7	71.5	66.0	65.7	66.5
16	63.5	108.0	78.0	61.0	84.0	79.6	61.0	81.0	81.2	61.6	74.8	80.6	62.7	70.0	77.6	66.0	67.0	72.0	66.5	66.0	66.7
17	67.0	94.0	79.0	64.0	80.5	78.2	63.0	77.0	78.4	64.0	73.0	77.6	65.0	69.5	75.5	67.0	67.6	71.2	67.0	66.8	67.0
18	66.0	74.0	65.0	66.0	70.0	65.0	66.5	69.0	66.0	67.0	68.5	66.6	67.0	67.5	66.5	68.0	67.3	67.0	67.0	66.7	66.0
19	65.0	79.0	71.0	64.8	77.2	72.0	64.3	74.5	72.0	64.3	72.0	71.6	64.5	69.0	70.5	65.2	67.8	68.5	65.2	65.5	65.8
20	66.0	83.5	73.0	64.0	75.0	74.5	64.0	73.7	75.5	64.0	71.0	74.7	64.0	68.5	72.2	65.6	66.8	69.2	65.7	65.7	65.7

21	**64.0**	**87.0**	**80.0**	61.7	**82.5**	79.5	**61.5**	**78.2**	**79.5**	**61.5**	**73.7**	**78.5**	**62.5**	**69.5**	**75.5**	**65.0**	**65.5**	70.7	**65.5**	**65.5**	**65.7**
22	69.0	86.8	....	64.7	82.5	....	64.2	77.2	....	64.0	72.2	....	64.5	72.2	....	66.2	68.0	....	66.0	66.1	....
23	69.0	93.0	80.0	68.0	79.0	78.0	68.0	77.5	78.5	68.5	75.5	77.7	68.5	72.5	76.0	69.0	69.7	72.0	67.5	67.2	67.5
24	70.5	95.0	80.0	67.5	86.0	80.2	67.5	82.5	81.7	67.2	77.5	81.2	67.7	73.0	78.7	68.7	69.7	74.0	66.7	67.7	68.0
25	68.0	105.0	83.0	65.0	85.5	82.5	65.0	82.5	83.0	65.2	77.5	82.0	65.7	72.7	79.2	67.2	69.9	74.0	68.0	68.0	68.0
26	68.5	96.0	77.5	64.5	81.7	78.0	64.5	78.2	79.2	65.2	74.7	79.0	66.0	71.2	72.5	68.2	69.0	72.7	68.0	67.7	68.0
27	68.0	96.0	79.5	68.0	82.2	80.0	68.0	78.6	81.0	68.6	74.8	80.5	68.5	72.0	78.0	69.6	70.0	73.5	68.2	68.2	68.5
28	70.5	102.5	82.0	66.2	85.7	82.0	66.0	81.0	83.0	66.0	78.0	81.8	66.5	73.6	79.0	68.7	70.0	74.5	68.5	68.2	68.8
29	67.0	109.8	82.0	66.0	89.9	84.0	62.2	82.7	84.4	67.0	77.2	83.0	67.5	73.1	80.0	68.0	70.0	75.0	67.2	68.2	69.0
30	72.0	109.0	87.0	68.0	90.5	88.0	68.0	85.0	87.5	68.6	80.5	86.0	69.0	75.7	82.5	70.6	71.8	76.6	69.5	69.4	69.8
31	73.0	100.0	74.0	70.0	87.5	74.5	70.0	83.8	76.8	70.0	80.0	77.8	70.5	76.3	77.0	71.8	72.7	74.6	70.0	70.0	70.0

READING OF SOIL THERMOMETERS — (*Continued*).

1888.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
August 1	67.0	96.0	78.0	64.7	81.0	79.6	65.6	78.6	81.5	66.5	76.0	87.0	67.5	72.6	78.5	70.0	70.5	74.5	69.7	69.0	69.5
2	64.0	103.0	81.0	63.0	85.7	81.0	64.0	80.8	81.8	65.0	76.3	81.0	66.3	72.4	78.0	69.0	70.0	74.0	69.2	69.0	69.0
3	67.5	106.5	85.0	66.5	89.0	85.0	66.0	81.7	84.7	66.6	77.5	83.0	67.0	73.0	79.5	69.0	70.0	74.5	69.0	69.0	69.2
4	72.5	88.0	84.0	72.2	82.8	82.8	72.0	80.0	82.8	72.6	77.6	81.9	72.5	75.0	....	72.2	72.6	75.8	70.0	70.0	70.3
5	70.7	87.0	78.0	70.0	82.5	79.0	70.2	80.1	80.0	71.0	77.2	80.0	71.0	74.5	78.0	72.0	72.2	75.2	70.2	70.5	75.2
6	70.5	104.0	86.0	69.3	88.6	85.6	69.0	82.0	86.2	69.8	78.0	85.0	70.0	74.5	82.0	71.5	72.0	77.0	70.7	70.6	71.0
7	75.5	95.5	83.5	72.2	84.0	84.0	72.3	81.5	85.5	72.6	79.0	84.3	72.5	76.3	81.6	73.0	74.0	77.2	71.5	71.5	72.0
8	71.0	105.0	80.0	70.0	89.2	82.6	70.0	85.0	85.5	71.0	81.0	85.8	71.2	77.0	83.2	72.5	73.5	78.0	71.5	71.3	72.0
9	68.0	93.8	78.0	65.5	81.8	81.0	67.8	77.8	83.0	69.5	76.0	82.3	70.5	73.4	80.0	73.0	72.5	76.0	72.0	71.5	71.5
10	67.0	96.0	68.0	63.5	85.0	81.0	64.4	79.0	82.5	65.5	76.0	81.7	66.5	72.5	79.0	70.0	70.5	75.0	70.7	70.0	70.0
11	62.0	71.0	72.5	63.0	69.0	73.5	64.6	67.2	75.0	66.0	67.2	74.0	67.0	67.5	72.5	69.5	68.6	70.6	70.0	69.7	69.0
12	60.5	82.0	69.0	60.7	77.2	70.0	62.0	71.0	71.0	63.7	69.0	71.7	65.0	68.2	71.0	67.0	67.0	70.0	68.0	67.8	68.2
13	60.0	71.0	62.5	60.8	65.0	63.0	62.0	64.0	65.5	63.2	64.0	66.3	64.5	64.0	66.0	66.8	65.8	66.6	67.8	67.0	66.8
14	59.0	84.5	71.5	57.5	74.0	72.0	57.5	68.7	73.0	58.0	66.4	72.0	59.0	64.2	69.5	62.8	63.7	68.0	66.0	65.2	66.0
15	63.5	94.0	76.0	63.0	77.0	75.0	63.0	73.0	76.2	63.8	69.8	76.0	64.0	67.0	73.5	65.3	66.0	70.0	66.0	66.0	66.5
16	69.0	90.0	79.5	69.0	84.0	79.5	69.0	79.8	80.0	69.0	76.7	79.3	68.7	73.0	77.0	67.3	70.0	73.0	68.7	67.7	67.5
17	69.5	82.0	74.0	69.8	77.5	75.0	70.0	74.8	76.0	71.0	73.0	76.5	71.0	71.5	75.0	71.2	70.6	73.0	69.2	69.0	69.0
18	64.0	78.5	71.0	64.5	75.3	72.7	65.0	73.0	73.6	66.0	71.0	74.0	67.0	69.0	73.0	69.0	69.0	71.0	69.0	69.0	69.0
19	68.0	94.0	76.0	62.3	75.2	77.0	62.5	73.2	79.5	63.0	70.7	78.5	64.0	68.2	75.5	66.7	67.5	71.7	68.1	67.7	68.3
20	66.0	97.0	72.5	63.6	82.0	74.0	64.4	77.5	76.5	65.5	74.0	77.0	66.0	70.5	75.0	68.0	68.8	72.0	68.5	68.5	78.5

21	64.0	75.0	67.5	64.0	72.3	68.5	63.8	70.7	69.0	64.8	69.0	69.5	65.5	67.5	69.0	67.7	67.7	68.8	68.3	68.0	68.0
22	58.5	63.3	61.0	60.0	63.3	64.8	61.0	63.3	66.5	63.0	63.7	66.8	64.0	64.0	66.0	66.0	65.6	66.2	67.0	67.0	66.7
23	58.0	90.0	64.0	54.7	72.0	64.6	55.0	73.0	66.0	56.7	67.0	66.0	58.0	64.0	65.5	62.0	63.5	65.3	65.4	65.0	65.0
24	67.0	99.0	74.0	62.5	81.0	76.0	62.3	76.0	78.0	63.3	72.0	77.0	62.0	68.0	74.5	63.5	65.0	70.0	65.0	65.0	65.6
25	68.0	107.0	78.0	66.5	82.6	80.0	66.4	80.0	81.5	66.7	75.5	80.6	66.5	71.5	77.5	67.5	68.5	72.5	66.5	66.5	67.0
26	69.7	109.0	80.0	65.0	84.2	81.0	65.0	80.2	82.0	66.7	75.8	81.0	66.0	71.8	78.0	67.7	68.7	73.0	67.0	66.8	78.0
27	63.0	73.5	67.0	65.0	68.3	71.0	66.8	67.8	73.0	68.0	67.7	72.8	69.0	67.0	71.5	70.0	68.2	69.6	68.3	68.0	67.6
28	58.0	99.0	70.0	57.0	78.0	74.2	57.8	74.2	76.0	59.0	64.2	75.5	60.5	66.0	63.0	64.5	65.0	69.5	66.6	66.0	66.0
29	61.0	99.0	74.0	61.0	76.8	75.5	62.0	73.5	76.0	62.7	70.0	75.0	63.5	67.0	73.0	65.5	66.0	69.6	66.5	66.0	66.0
30	63.7	103.0	81.0	62.6	82.5	81.0	63.0	78.0	80.8	63.7	73.5	80.0	64.0	69.5	77.0	66.0	67.0	71.7	66.5	66.2	67.0
31	66.0	90.0	73.0	66.0	81.0	73.2	66.6	78.0	74.0	67.5	76.0	74.5	67.5	72.0	73.0	68.8	68.2	71.0	67.5	67.6	68.0

READING OF SOIL THERMOMETERS — (*Continued*).

1888.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES,			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M,	6 P.M.
September 1	62.5	64.0	63.0	63.5	63.5	62.5	65.0	64.0	64.5	66.0	65.0	65.0	67.0	65.5	65.0	68.0	67.0	66.3	67.5	67.0	66.7
2	59.0	97.0	70.0	55.0	76.0	73.0	55.7	70.0	75.0	57.0	66.2	74.0	58.2	65.2	71.5	62.0	63.0	68.0	64.7	64.8	65.0
3	58.0	95.0	71.0	58.0	75.0	73.0	58.0	73.0	74.7	59.5	68.8	74.0	60.5	65.3	72.0	63.5	64.0	68.5	65.0	65.0	65.0
4	63.0	87.0	76.0	61.5	88.7	76.0	61.5	75.5	76.0	62.5	72.0	75.0	63.0	68.0	72.5	65.0	65.5	69.0	65.5	65.3	65.7
5	60.0	97.0	64.0	61.0	74.5	69.5	62.0	73.5	73.0	63.5	70.0	73.5	64.0	67.0	72.0	66.0	66.0	69.0	66.0	66.0	66.0
6	52.5	94.0	63.0	52.0	71.0	68.0	53.5	70.0	70.5	55.5	66.0	70.7	57.5	63.0	69.0	61.7	62.6	66.5	64.5	64.5	64.5
7	51.0	83.0	63.5	51.2	68.0	64.5	52.5	66.0	65.7	55.0	63,5	66.0	56.5	61.0	65.5	61.0	61.0	64.0	64.0	63.0	63.0
8	55.5	69.0	67.5	55.5	64.5	68.5	56.0	62.0	67.0	57.0	60.5	66.6	58.0	59.5	65.0	60.0	61.0	63.0	62.0	62.0	63.0
9	61.5	84.0	71.0	60.0	74.6	71.7	60.5	72.0	73.0	60.7	69.1	72.3	61.0	65.7	70.5	62.0	63.0	67.0	63.0	62.6	63.7
10	58.0	78.0	67.0	57.8	72.5	69.5	58.5	71.0	71.5	60.0	68.0	71.0	61.0	65.0	69.0	63.5	64.0	67.5	64.0	64.0	64.0
11	55.5	87.0	70.5	56.5	73.6	72.0	57.0	72.5	73.3	58.5	68.0	72.5	60.0	64.5	70.0	62.5	63.0	67.0	64.0	63.7	64.0
12	60.0	78.0	68.0	60.0	73.5	70.6	60.0	70.8	72.6	61.0	68.0	72.0	61.5	65.0	70.0	63.5	64.0	67.0	64.0	64.0	64.0
13	55.0	68.0	59.0	56.2	65.7	61.0	57.5	64.3	64.5	59.5	63.3	65.0	60.5	62.0	64.5	63.0	62.6	64.0	64.0	63.8	63.8
14	50.5	86.0	66.0	50.6	69.3	68.1	51.5	69.8	70.5	52.5	64.5	70.0	53.0	61.0	68.0	59.0	60.0	64.6	62.5	62.0	62.0
15	53.5	79.0	65.0	53.7	70.0	66.2	54.0	68.8	67.5	56.0	65.0	67.0	57.0	62.0	66.0	60.0	61.0	64.0	62.0	62.0	62.0
16	57.5	65.0	65.0	58.0	63.4	65.0	59.0	62.2	65.0	60.0	61.5	64.2	60.5	61.0	63.5	62.0	61.1	62.8	62.5	61.8	62.0
17	60.0	84.5	67.0	60.5	73.6	66.8	60.8	73.0	67.5	61.2	70.0	68.0	61.5	66.0	67.5	62.3	63.5	66.0	62.2	62.7	63.0
18	65.0	87.0	69.0	64.0	74.0	69.5	64.0	74.6	71.0	64.5	71.5	71.0	64.5	68.0	70.0	64.5	65.0	68.0	63.8	64.0	64.0
19	63.0	75.0	65.0	62.0	71.0	65.6	62.0	69.8	67.0	63.0	68.5	67.5	63.5	66.5	67.0	65.0	65.0	66.5	64.8	64.8	64.8
20	55.0	74.9	64.0	59.0	70.0	65.2	59.5	68.6	67.4	60.5	66.1	68.8	61.5	64.3	66.5	63.5	63.5	65.1	64.5	63.5	63.6

21...........	56.5	74.5	62.5	56.2	69.0	64.0	57.0	67.0	64.9	58.1	64.8	64.8	59.5	62.5	65.0	61.9	62.1	64.0	63.0	63.0	63.0
22...........	57.0	66.5	60.0	57.0	63.3	62.0	57.0	62.0	64.5	58.0	61.0	64.7	58.5	60.3	64.0	61.0	61.0	63.0	63.0	62.8	62.5
23...........	57.2	81.0	62.0	56.2	67.0	64.0	57.5	65.9	66.7	58.0	63.8	67.0	58.0	61.5	65.4	60.0	61.0	64.0	61.7	61.9	62.3
24...........	52.0	85.0	66.0	52.6	69.0	68.0	53.5	69.0	70.4	55.0	65.5	70.0	56.0	62.0	67.5	59.8	60.6	64.8	62.0	62.0	62.0
25...........	54.0	66.0	58.0	54.5	64.8	59.0	55.0	63.0	60.0	56.5	61.8	61.3	57.5	60.5	60.5	60.5	60.5	61.0	62.0	62.0	61.6
26...........	53.0	80.5	62.0	51.0	68.3	61.0	52.0	68.0	63.0	53.6	64.5	64.3	55.0	60.5	63.5	58.2	59.0	62.0	61.0	61.0	61.0
27...........	54.0	63.5	55.0	54.0	62.0	56.0	55.0	61.0	57.6	56.5	60.8	59.0	57.5	59.5	59.0	59.7	59.7	59.8	61.0	61.0	60.6
28...........	47.5	66.5	50.0	49.0	59.0	53.0	50.0	59.0	55.5	51.6	57.0	57.0	53.0	55.5	57.0	56.2	66.5	58.0	59.6	59.0	59.0
29...........	42.0	71.0	47.5	43.8	57.0	50.0	45.0	55.6	51.4	47.7	54.7	53.0	49.7	53.0	53.5	54.0	54.4	55.0	58.0	58.0	57.0
30...........	43.5	66.0	49.5	43.5	57.5	51.0	44.0	55.3	53.0	46.0	53.5	54.0	47.5	52.0	54.5	51.2	52.2	55.0	55.5	56.9	56.0

READING OF SOIL THERMOMETERS—(*Continued*).

1888.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
October 1	45.5	48.0	51.0	46.0	48.0	51.0	46.8	48.0	51.0	48.5	49.0	51.0	49.5	49.5	51.0	52.8	52.0	52.5	56.0	55.5	55.0
2	48.0	51.0	46.0	48.0	50.0	47.0	48.0	50.0	48.0	50.0	50.5	49.5	50.5	50.5	50.5	52.6	52.5	52.5	55.0	55.0	55.0
3	40.0	58.0	40.0	40.0	49.0	41.0	41.5	49.0	43.0	43.5	47.8	45.0	45.0	47.0	46.0	49.5	49.5	50.0	54.0	54.0	53.0
4	40.0	45.0	46.0	40.0	44.0	46.0	40.5	43.6	46.0	42.0	44.0	47.0	43.0	44.0	47.0	47.0	47.0	48.0	52.3	52.0	52.0
5	47.0	63.0	54.5	46.0	57.2	54.2	46.2	55.5	55.0	48.6	53.0	55.0	47.0	50.5	53.5	49.0	50.0	53.0	52.0	52.0	52.8
6	49.0	51.0	50.0	49.0	50.0	50.0	49.5	50.3	50.5	50.0	50.7	51.0	50.5	50.5	51.0	52.0	51.8	52.0	53.5	53.5	53.5
7	43.0	57.0	50.0	43.0	53.0	53.0	43.5	52.8	51.8	35.2	51.2	52.0	46.5	50.0	52.0	49.5	50.2	52.0	52.5	52.3	53.0
8	47.0	52.0	44.0	47.0	51.0	45.0	47.8	51.0	47.0	48.8	50.8	49.0	49.0	50.0	50.0	51.0	50.7	51.2	53.0	53.0	52.7
9	38.0	43.0	37.0	39.3	41.8	39.0	40.3	42.0	41.0	42.5	42.8	43.0	44.0	43.5	44.0	48.0	47.0	47.0	52.0	51.8	51.0
10	33.0	62.5	43.0	36.0	47.7	46.0	37.0	50.0	48.0	38.0	47.0	49.0	40.5	44.5	49.0	45.0	45.5	49.0	50.0	50.0	50.0
11	33.5	62.0	45.0	37.0	52.0	47.0	37.5	51.0	48.0	39.5	48.3	49.0	41.0	46.0	48.5	45.5	46.0	49.0	50.0	49.8	50.0
12	43.0	47.0	47.0	43.0	46.0	47.0	43.0	45.0	47.0	44.0	45.0	47.0	44.5	45.0	47.0	47.0	47.0	48.0	50.0	49.8	49.0
13	43.5	58.0	49.0	43.7	52.0	49.2	44.0	49.0	50.0	45.0	48.0	50.0	45.0	48.0	50.0	47.4	47.8	50.0	50.0	50.0	50.0
14	44.5	51.0	45.0	44.0	48.2	46.2	45.0	47.5	47.8	46.0	47.0	48.0	46.2	47.0	49.0	48.0	48.0	49.5	49.7	50.1	50.5
15	38.5	64.0	48.0	39.5	52.6	48.0	40.0	53.0	49.0	42.0	51.0	50.5	43.5	48.5	50.5	47.0	48.0	50.0	50.0	50.0	50.0
16	45.0	49.0	47.0	45.0	54.0	48.0	45.0	54.5	50.0	46.0	52.6	51.0	46.5	50.0	51.0	48.5	49.0	51.0	50.5	50.6	51.0
17	43.5	58.0	47.0	44.6	53.2	48.0	45.0	52.8	49.0	46.0	51.0	50.2	47.0	49.5	50.6	49.0	49.0	50.0	50.8	51.0	50.8
18	43.0	63.5	44.0	43.2	51.0	46.0	43.7	52.5	48.0	45.0	50.7	50.0	46.0	48.5	50.0	48.2	48.5	50.2	51.0	50.8	51.0
19	40.0	47.0	48.0	40.0	45.2	47.8	40.8	44.5	47.0	42.0	44.5	47.0	43.0	44.2	46.0	46.5	46.0	47.3	50.0	49.7	49.5
20	41.5	50.0	41.5	42.0	45.8	41.0	42.8	46.0	43.5	44.0	45.0	44.8	44.5	45.0	45.5	47.0	46.8	47.0	49.5	49.6	49.4

21..............	36.0	38.5	36.0	36.0	38.4	37.5	37.0	39.0	38.0	39.0	39.6	39.5	40.5	40.5	40.0	44.0	43.5	43.8	47.7	47.8	48.0
22..............	35.0	54.0	42.5	36.0	47.0	43.0	36.2	46.0	43.8	38.0	44.0	45.0	39.0	42.0	45.0	42.6	43.0	45.0	47.0	47.0	47.0
23..............	....	50.0	49.0	....	47.5	48.0	....	46.5	48.0	....	45.6	48.0	....	45.0	47.5	....	45.3	47.0	....	47.4	47.6
24..............	45.0	54.0	45.5	45.6	48.2	46.0	46.4	48.7	47.0	47.0	48.0	48.0	47.0	47.8	48 0	48.0	48.0	48.0	48.5	48.7	49.0
25..............	39.5	60.0	50.0	40.0	50.5	50.5	40.0	52.3	51.8	41.8	50.0	51.0	44.3	47.0	....	45.8	46 5	49.8	48.4	48.6	49.0
26..............	42.0	58.0	49.5	42.0	53.0	50.0	43.0	52.5	50.0	43.0	51.0	51.0	44.2	48.5	50.5	47.5	47.8	50.0	49.0	49.0	49.5
27..............	46.0	57.0	52.0	45.2	52.5	52.0	46.0	51.2	52.0	46.7	50.5	52.0	47.0	49.5	51.0	48.0	49.0	50.0	49.0	49.8	50.0
28..............	50.0	46.0	42.5	49.2	45.0	44.8	49.5	46.1	46.0	49.7	47.3	48.0	49.0	48.0	48.0	49.5	49.2	49.0	49.7	49.8	50.2
29..............	40.0	51.0	44.0	40.8	46.4	43.7	41.0	46.8	45.0	41.5	46.0	46.0	43.5	45.0	46.5	46.0	46.0	47.0	49.0	49.0	48.0
30..............	37.0	50.0	38.0	37.5	42.5	41.5	38.6	43.0	43.0	40.0	42.7	45.0	41.5	42.0	45.0	45.0	44.0	46.0	48.2	46.5	48.0
31..............	38.5	63.5	52.0	38.5	53.0	52.0	38.5	52.0	51.5	39.5	48.8	52.0	40.0	45.5	50.5	42.0	44.8	48.0	46.5	47.4	47.8

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